CONGESTION RELIEF ANALYSIS

Spokane Area Report

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4 Spokane Area Report

4.0 Summary

This chapter documents the model analysis results of various congestion-relief scenarios in the Spokane area.[1] The results provide perspectives on the degree to which congestion can be reduced in the region. The congestion-relief options are varied: provide sufficient transportation supply to meet demand, or reduce the vehicular portion of the demand through expanded transit facilities and services.

What are the growth challenges in the region?

Like the State's other two metropolitan areas, Spokane will continue to experience growth in population, employment and new trips.

Table 4-1 shows the regional growth forecasts for the period between 2000 and 2025. These forecasts indicate that population and employment are expected to increase by 47% and 49% respectively in the region.

Table 4-1: Spokane Forecasted Regional Growth 2000 to 2025

207,000	New Residents	+47%
98,000	New Jobs	+49%
146,000	New Vehicles	+46%
177,000	New Commute Trips	+51%

Source: SRTC

Based on current plans, if additional revenue to build projects is not identified[2], Spokane's regional roadway network would experience a 100% increase in daily vehicle hours of delay by 2025 (from 31,000 hours today to 62,000 hours). The region will only be able to build a marginal amount of lane miles (a 9% increase over today) based on current funding availability.

What improvements (scenarios) were modeled?

The focus of the study was to evaluate the congestion relief potential of system-wide transportation improvement scenarios in the Spokane area. A series of data points including highways and transit strategies individually and in combination were established. These data points help to assess and discern differences between different strategies as well as the level of investment and the results of congestion relief as predicted by computer models.

Analysis Approach and Context

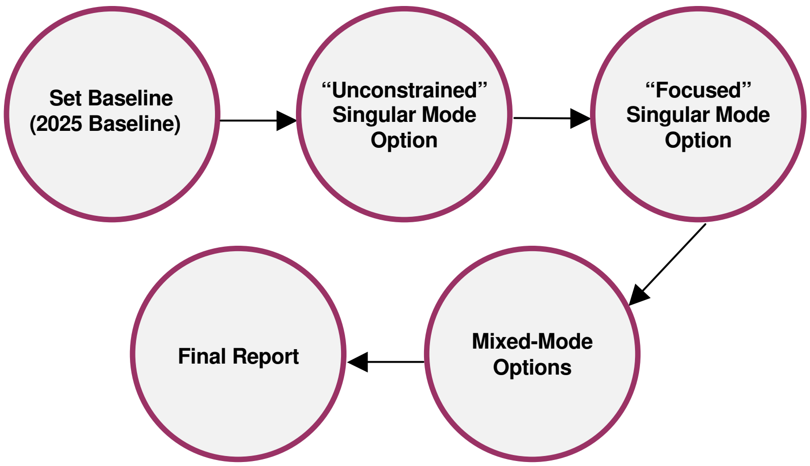
The analysis process used for the Congestion Relief Study looked at a wide-range of system-wide improvements to address congestion in the Spokane area. The primary tool that was used in this analysis is the SRTC travel demand model. The assumptions, process and scenarios developed for the study were aimed at understanding the congestion issue at the system level. However, the level of analysis conducted is less detailed than what would be done in a traditional corridor study (e.g., project-level planning). Care should be taken in reviewing and applying the results of the analysis for future planning applications. More detail on the analysis methods and assumptions can be found in Chapter 1 Study Methodology.

[1] The report summarizes data and results from various transportation scenarios studied during the Urban Areas Congestion Relief Analysis. It is not meant to recommend a specific strategy nor is it intended to replace, update, or propose a specific local, regional or statewide plan, policy or agreement. Information contained in this report should be used and discussed in the context of this study only.

[2] Since the model analysis was completed in 2004, the new transportation projects funded by the 2005 Transportation Partnership Account were not reflected in the analysis.

As shown in Figure 4-1, the scenarios were developed in phases. Seven different year 2025 scenarios assuming the same future land use and total number of trips were developed and modeled using the Spokane Regional Transportation Council (SRTC) regional forecasting model. They include a baseline scenario (including only committed and funded projects), four scenarios that focused exclusively on roadways or transit, and two mixed scenarios that included both highway and transit investments. In addition, a capacity-unconstrained highway demand forecast was developed to provide an analysis reference point. The unconstrained forecast was used to identify the highest demand by corridor.

Figure 4-1: The Study Process



What were the Model Results?

The study evaluated transportation performance and the impacts of each scenario at both a region-wide and a corridor level. The following three questions are addressed in the study:

1. How well does each scenario reduce congestion?
2. What are the potential costs of each scenario?
3. What are the potential impacts to the environment for each scenario?

How well does each scenario reduce congestion?

Each scenario was analyzed to assess the extent to which it reduced roadway congestion levels. The analysis metrics were a mixture of system-level and corridor-specific measures related to delay for persons, vehicles and trucks, hours of congestion each day, and travel time on major freeway corridors.

Vehicle delay is expected to increase over today's level if there are no significant new investments in transportation capacity and services. Even with a marginal increase in highway capacity assumed in the 2025 Baseline, delay will increase by 100% over today's level. All of the scenarios tested would reduce delay compared to the 2025 Baseline, though system-wide, no scenario provides delay reductions to today's levels. This is largely a function of forecasted growth in person trips resulting from an increase in population and employment.

All scenarios do provide travel time savings for trips between important origins and destinations. In general, due to forecasted low transit usage, the computer model predicted that highway investments tend to provide more travel time savings than transit investment on per dollar basis.

- The highway-oriented scenarios (with varying levels of transit investment) produced substantial benefits distributed over the majority of system users. Among the scenarios tested, investments assumed in highway capital improvements were orders of magnitude greater than the transit costs considered in the transit-oriented scenarios.
- Highway investments tended to generate more benefits per dollar of investment than did the transit investments. This may be due to the scale of transit investments exceeding their potential cost-beneficial range by a larger margin than the highway investments analyzed. This indicates that transit in Spokane is even less an effective congestion relief option than in the Central Puget Sound area.

What are the potential costs of each scenario?

Most of the scenarios analyzed would cost billions of dollars. The capital costs, in current dollars, range from approximately $1.3 - $1.6 billion for the scenario that focuses on transit investments (Transit Focus Scenario) to $6.8 - $8.9 billion for the scenario that focuses on roadway investments (Highway Focus Scenario).

Operations and maintenance (O&M) costs are generally much higher for transit-oriented scenarios than for highway-oriented scenarios. The O&M costs estimated in this study are above and beyond the estimated $74 million in annual costs needed to maintain and operate the existing transportation system (roadway and transit) in the Spokane area.

The ability to fund the various improvements was not considered. It is conceivable that potential funding mechanisms for investments measured in the billions of dollars – such as a substantial increase in the gas tax – may affect travel behavior, and thus the level of improvements required to mitigate travel delays.

What are the potential impacts to the environment for each scenario?

The purpose of the environmental review was to identify the primary environmental factors contributing to the costs of each scenario, as well as the major areas where environmental impacts could be anticipated. The following observations can be made:

- All scenarios potentially involve substantial right-of-way needs and impacts to property, wetlands and streams. These effects were reflected in the cost estimates. The greatest impacts would be associated with highway-widening improvements. Most of the transit improvements were assumed to occur within existing transportation rights-of-way, usually on aerial guideways.[3]
- Air quality impacts are primarily associated with highway improvements. Transit improvements are anticipated to reduce vehicle trips and therefore reduce air pollutant emissions.
- Noise levels are expected to be highest with the highway-oriented scenarios; transit noise levels are expected to be low.

[3] Transit-related improvements would require additional right-of-way for park-and-ride facilities and transit vehicle maintenance and storage facilities. Transit right-of-way needs were identified only in corridors where the need was apparent, actual transit right-of-way needs may be more than what was identified in this analysis.

- Low-income and/or minority communities would experience both impacts and benefits related to the transportation scenarios. These communities may experience direct impacts such as right-of-way acquisition and increases in noise and air pollutants, primarily associated with the highway-intensive scenarios. Conversely, these and other populations will benefit from the provision of additional transportation capacity under all scenarios.
- Land use impacts are shaped by the growth management regulations in place within the region and by the small percentage of transportation capacity added outside of the adopted urban growth areas. While overall land use impact is difficult to assess, the highway-oriented scenarios are expected to have the most potential for conversion of existing land uses to roadway functions due to right-of-way needs.

The environmental assessment focused on environmental effects at the system level. Due to lack of design details, corridor-specific environmental reviews were not performed.

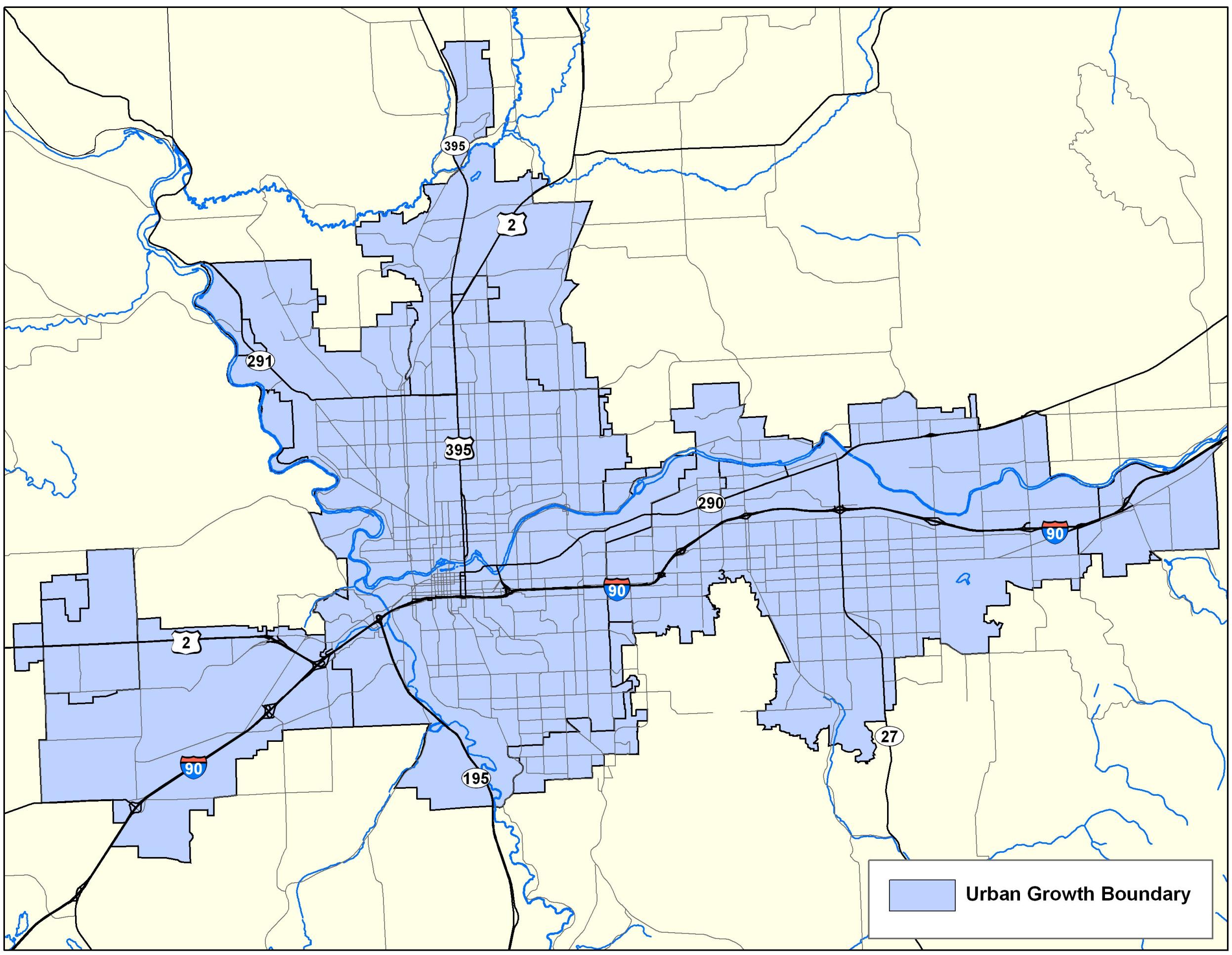
4.1 Study Area Definition

The Spokane Metropolitan Area is the largest population center in Eastern Washington and the second largest in Washington State. The study area for the Congestion Relief Analysis is generally defined by the following boundaries:

- West: Fairchild Air Force Base (South Brooks Road)
- East: Idaho State Line
- North: North Spokane Corridor/US 395 Interchange (Dartford)
- South: East Belle Terre Avenue

The area encompassed by these boundaries includes the communities of Spokane, Spokane Valley and Liberty Lake and Millwood in addition to rural areas of Spokane County (see Figure 4-2 below).

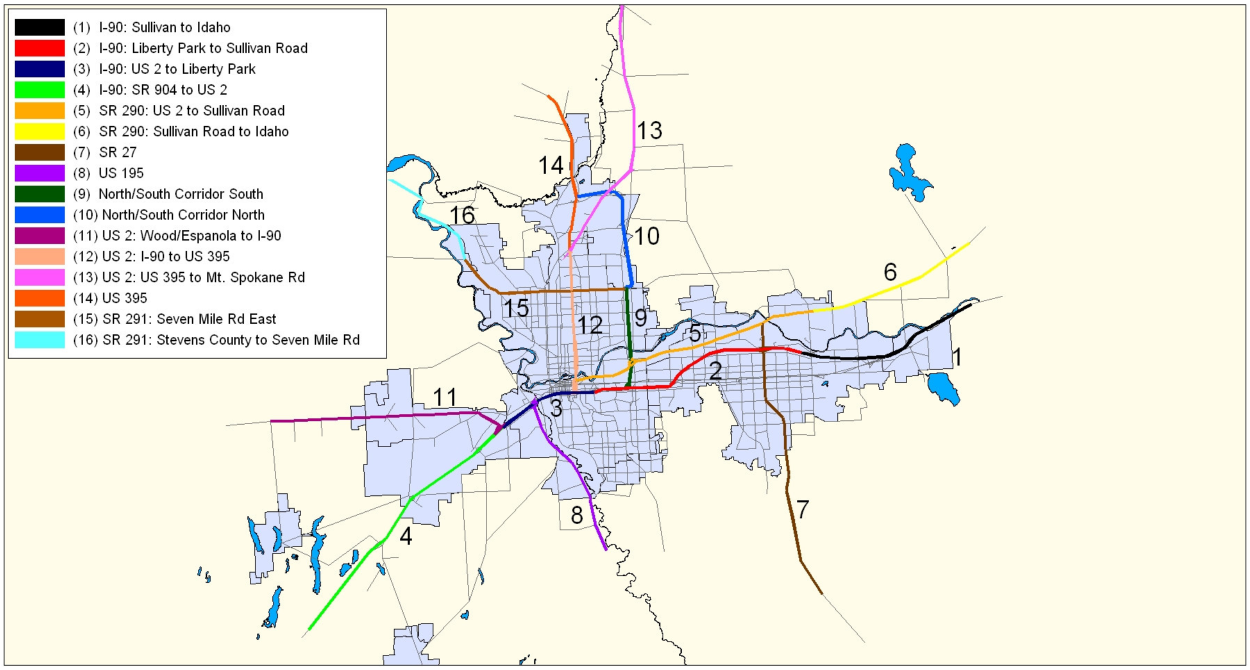
Figure 4-2: Spokane Study Area



4.2 Major Corridors

The study evaluates transportation performance and impacts at both region-wide and corridor levels for a number of different future scenarios. For the corridor-level analysis, 16 major corridors (8 roadway facilities) were identified and are illustrated in Figure 4-3.

Figure 4-3: Study Corridors in the Spokane Metropolitan Area



The major north-south facilities are:

- US 2, a state highway extending east from Puget Sound to Spokane and then turning north from I-90 in downtown Spokane to the Idaho State Line. The north-south section of US 2 running through the Spokane area was split up into two segments for analysis: I-90 to US 395 and US 395 to Day Mt. Spokane Road;
- US 395, a state highway that runs north from Spokane to Canada. The study segment runs from US 2 to Hatch Road;
- North Spokane Corridor, a planned state route extending north from I-90 in east Spokane to US 395. The study segment was split into two segments and covers the entire facility;
- US 195, a state highway that runs south from I-90 in west Spokane to the Idaho State Line. The study segment is from I-90 to Paradise Road; and
- SR 27, a state route that runs south from SR 290 in Spokane Valley to Pullman. The study segment runs from SR 290 to 32nd Avenue.

The major east-west facilities are:

- US 2, a state highway extending east from Puget Sound to Spokane and then turning north from I-90 in downtown Spokane to the Idaho State Line. The east-west study segment of this highway runs from Wood/Espanola to I-90;
- I-90, a transcontinental highway, beginning in Seattle and running all the way east to Boston. The segment included in the analysis starts at SR 904 in Four Lakes and ends at the Idaho State Line. This section of I-90 was split up into four segments for analysis:

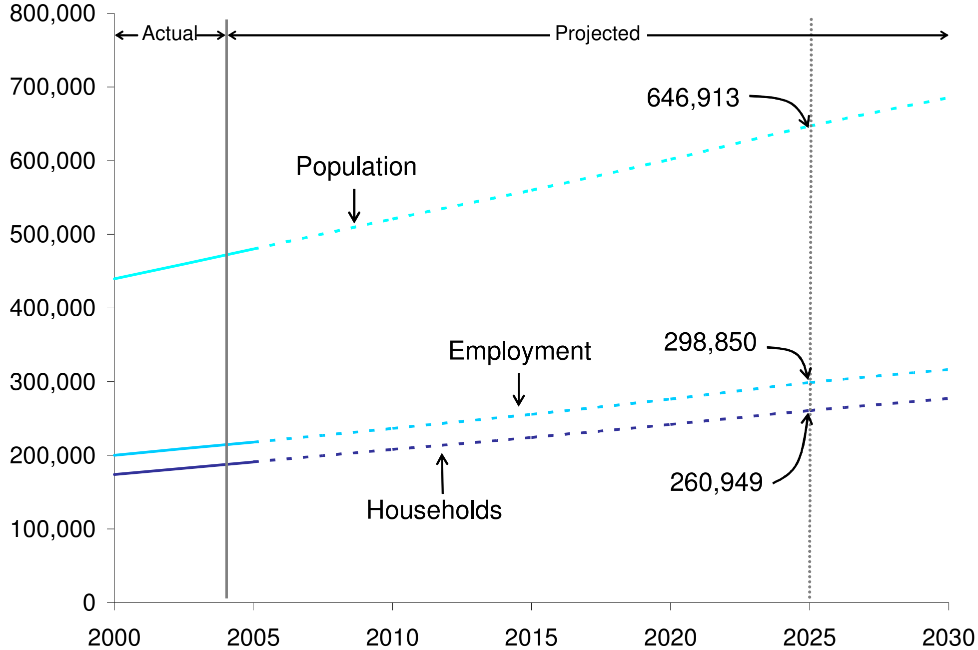
SR 904 to US 2, US 2 to Liberty Park interchange, Liberty Park interchange to Sullivan Road, and Sullivan Road to the Idaho State Line;

- SR 290, a state route that runs parallel and to the north of I-90 from US 2, east to the Idaho State Line. This facility was studied as two separate segments: US 2 to Sullivan Road, and Sullivan Road to the Idaho State Line; and
- SR 291, a state route extending west from north Spokane and traveling on the northern bank of the Spokane River to the Stevens County Line. This facility was split into two segments for analysis: Stevens County Line to Seven Mile Road, and Seven Mile Road to the North Spokane Corridor.

4.3 Existing and Future Population and Employment Projections

The SRTC developed forecasts of population, households and employment for the Spokane area for the years 2000, 2008, and 2025. The forecasts were prepared for 437 Traffic Analysis Zones (TAZ) for use in the Council's travel demand models. These data are summarized in Figure 4-4.

Figure 4-4: Spokane Area Growth Trends and Future Forecast



Source: SRTC

For the Spokane County, total population, households and jobs are projected to grow by 83,000, 35,000, and 40,000 per decade respectively for the next 30 years.

Figure 4-5 and Figure 4-6 show where the majority of the growth in population and employment will occur in the Spokane area. Areas outside of Spokane will see a high level of growth between 2000 and 2025. The most pronounced growth is expected to occur in North Spokane and Spokane Valley.

Figure 4-5: Projected Spokane Area Change in Population 2000 – 2025

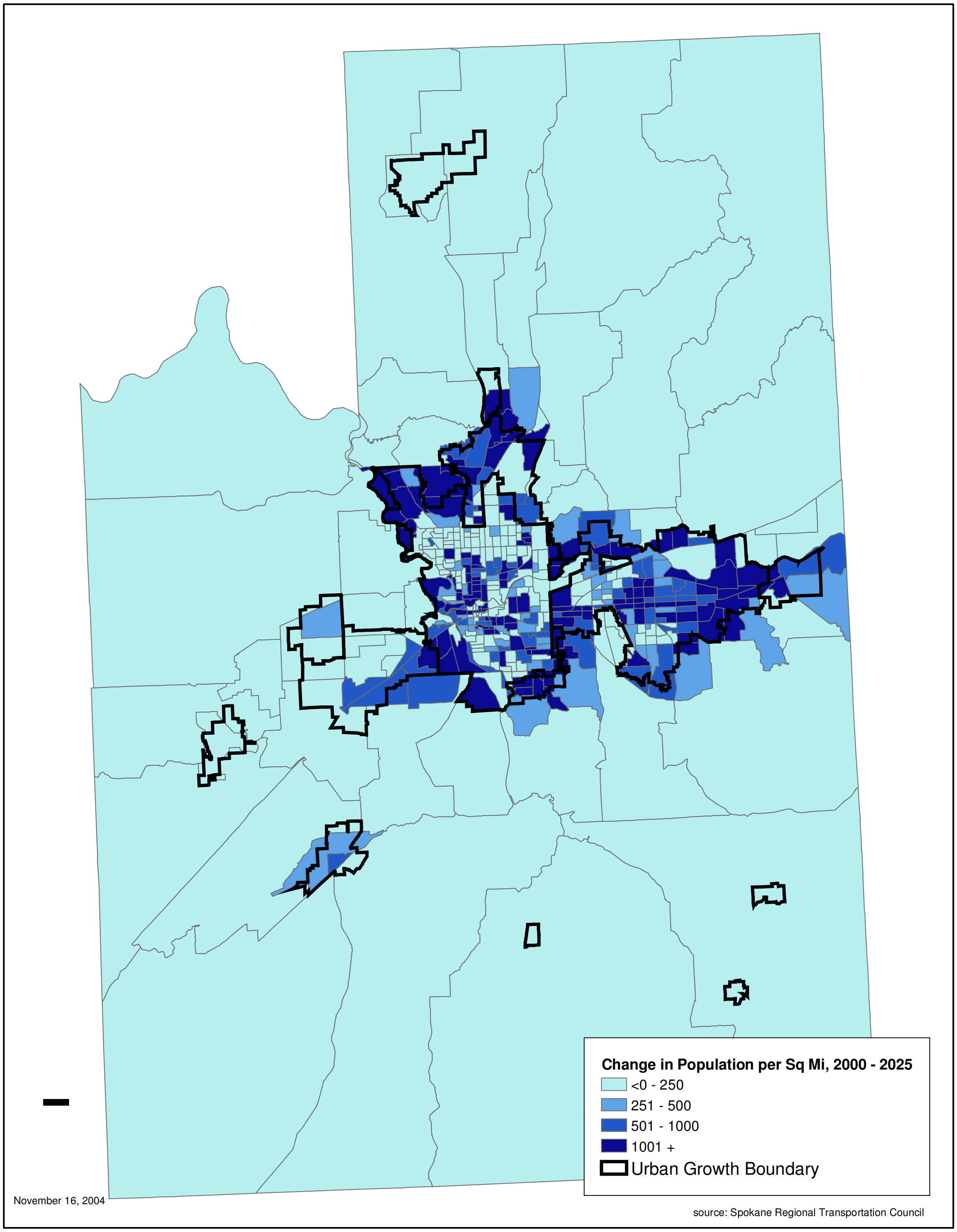
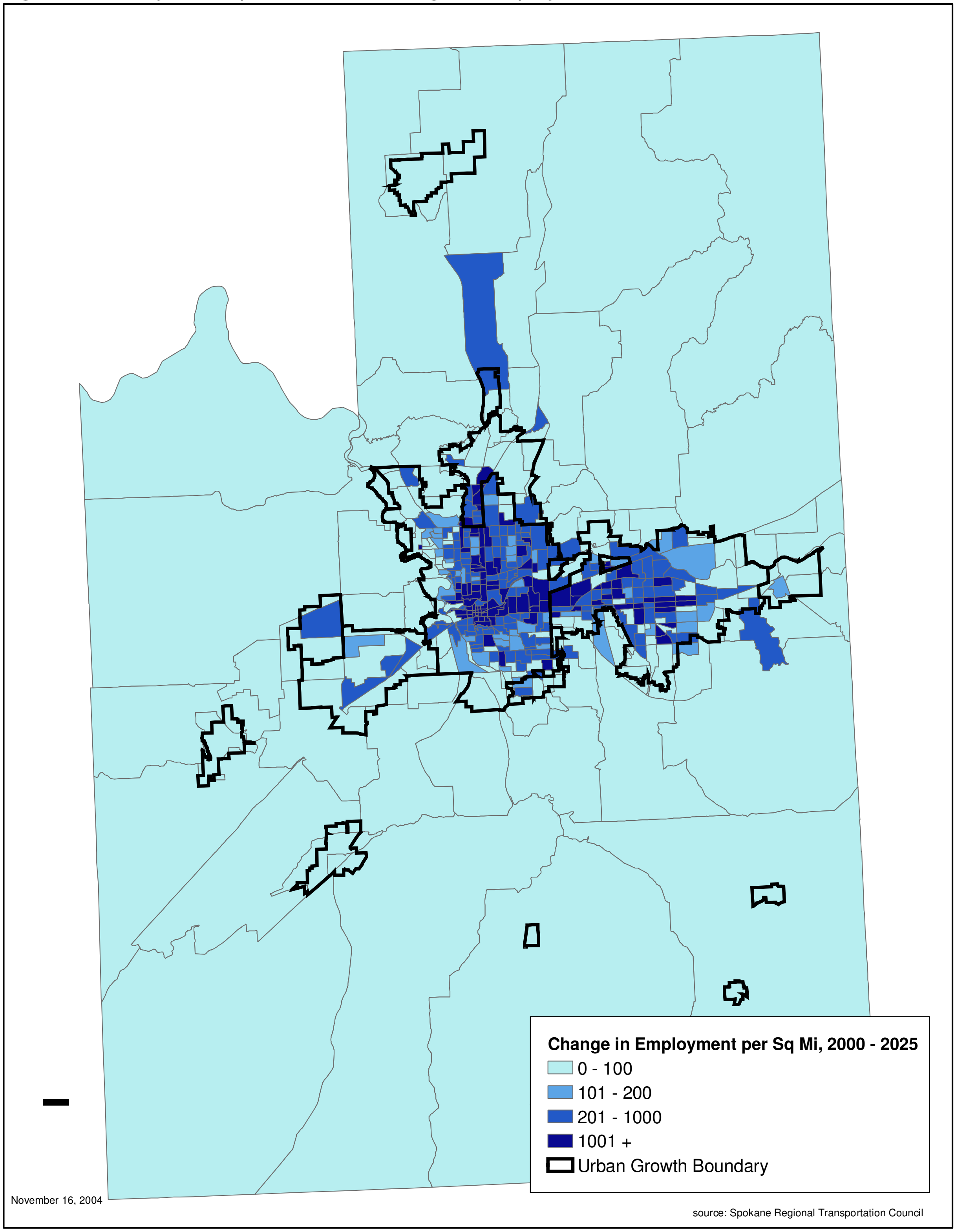


Figure 4-6: Projected Spokane Area Change in Employment 2000 – 2025



Existing and Future Travel

The substantial projected growth in population and employment translates into substantial growth in travel and congestion in the region. Figure 4-7 and Table 4-2 summarize model estimated travel characteristics for 2002 and the 2025 Baseline Scenario. The 2025 Baseline Scenario assumes existing facilities, plus committed projects identified by the Washington State Department of Transportation (WSDOT), regional and local transportation agencies prior to 2005. It includes projects that are under construction or have funding secured as part of the State's Nickel Funding program.

Figure 4-7: Growth in Trips, VMT, Lane Miles, and Transit Service (2002-2025)

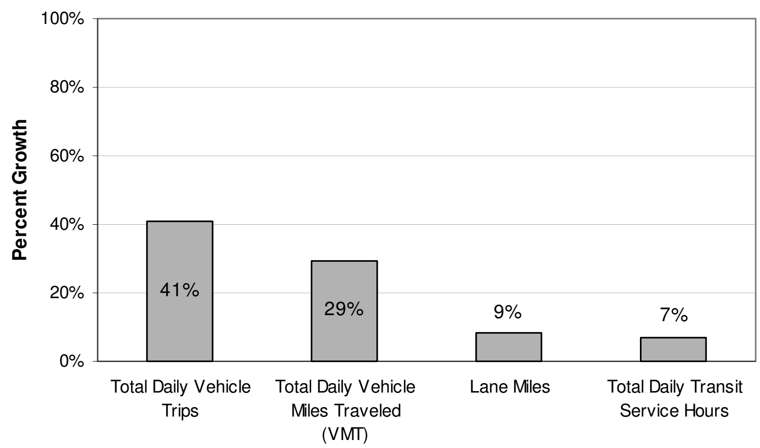


Table 4-2: System-Wide Summary of Travel Forecasts

	2002	2025 Baseline	Change 2002 - 2025
Daily Total Person Trips	2,840,200	4,012,200	+41%
Daily Total Vehicle Trips	2,028,000	2,855,000	+41%
Total Daily Vehicle Miles Travel (VMT)	12,358,400	16,003,000	+29%
Lane Miles (Freeways)	150	229	+52%[4]
Lane Miles (All Other Facilities)	1,445	1,502	+3.9%
Daily Transit Service Hours	4,380	4,730	+8%
Total Daily Vehicle Hours of Delay	30,600	61,400	+101%
Daily Commercial Vehicle Hours of Delay	1,180	2,280	93%

As shown in Figure 4-7 and Table 4-2, total daily person trips, vehicle trips, and vehicle miles traveled (VMT) are forecast to increase by approximately 30 to 40% by 2025. During this same time period, assuming there is no new significant transportation revenue, lane miles (freeway and arterials combined) will increase by approximately 8.5%. Daily transit service hours will increase

[4] For the purpose of this analysis, partially funded North Spokane Corridor was assumed to be completed by 2025, which accounted for over 70% of the freeway lane mile increase.

by approximately 8% by the year 2025, due to a modest expansion in bus service. By 2025 the increase in travel will result in a doubling of vehicle hours of delay, even with the planned additional roadway capacity.

Travel patterns in the region will also change by 2025, due in part to continued growth in households in Spokane's suburban communities. This will result in more trips being made to-and-from these communities. The roadway network in these areas should see higher demand and a greater increase in delay than what occurs today. Still, downtown Spokane will remain the region's leading destination well into the future. Growth in trips will continue to increase along corridors connecting to the greater downtown area.

4.4 Scenario Configurations

Seven transportation scenarios were developed for the Spokane area. They represent a range of possible options for reducing congestion. The scenarios were then modeled to see how effective they are in reducing congestion, and at what cost. The modeling began with existing conditions and a 2025 Baseline scenario (only includes projects with committed funding), followed by two scenarios that focused on highways and transit, two highway only scenarios that include progressively lower highway improvements than the Highway Focus Scenario and two mixed scenarios that included investments in more than one mode or type of capacity improvement.

In order to help define the analysis scenarios, the highway capacity-unconstrained forecast assumed there was abundant highway capacity to serve all the travel demand.

Existing Condition (2002)

For the Spokane area, the existing condition is represented by the system contained within the 2002 Spokane Regional Transportation Council's regional travel demand model.

Figure 4-8 shows the number of general-purpose (GP) lanes included in the Existing Condition Scenario. The Existing Condition also assumes approximately 4,400 daily passenger hours of transit service. Figure 4-9 shows the transit network assumed in the Existing Condition Scenario network.

Figure 4-8: General-Purpose (GP) Lanes Included in the Existing Condition Scenario

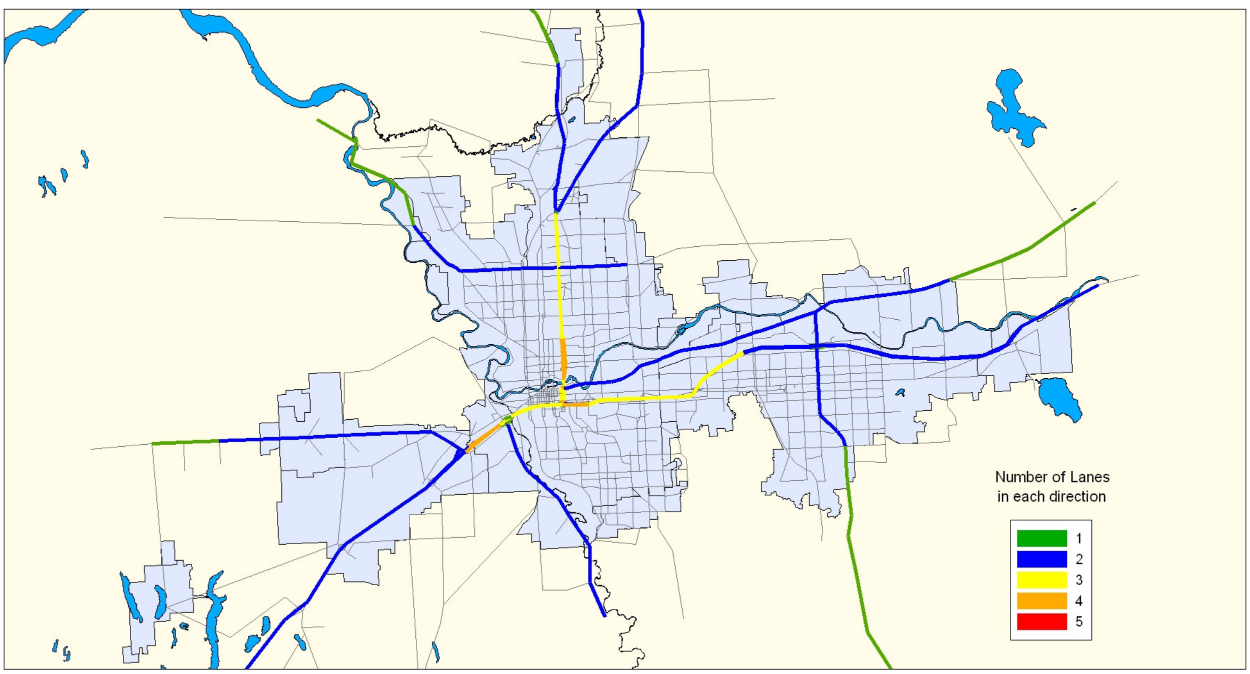
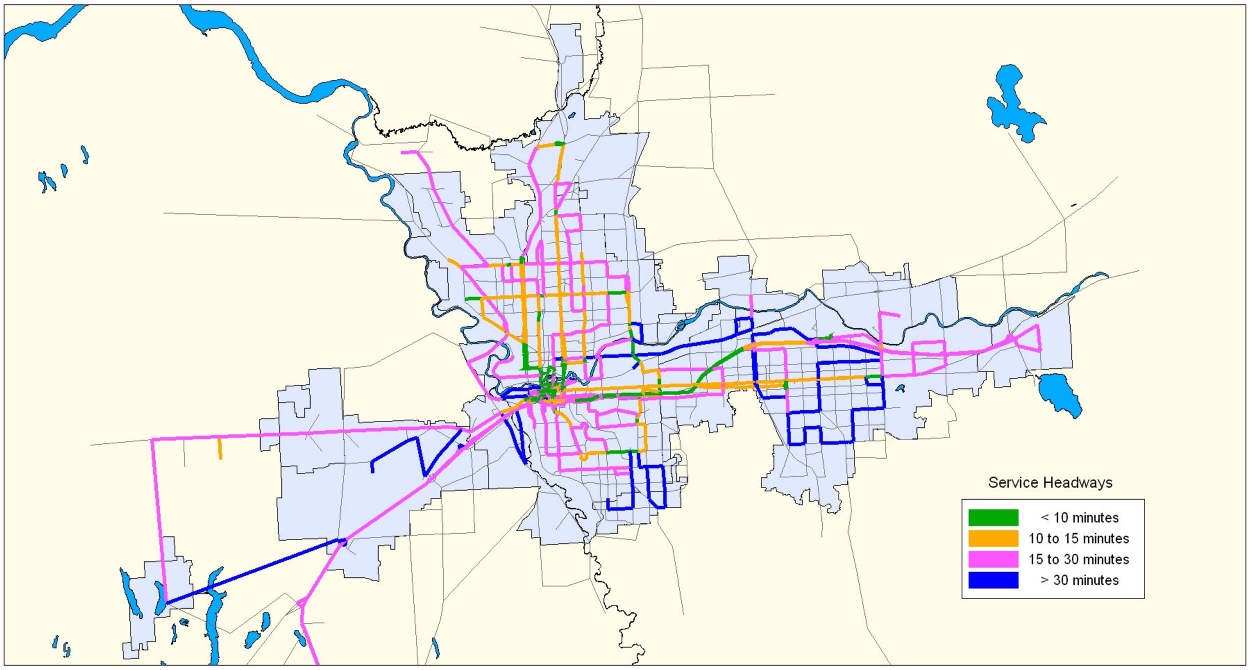


Figure 4-9: Transit Service Under the Existing Condition



2025 Baseline Scenario

The 2025 Baseline Scenario provides a point of reference for examining the various congestion relief scenarios. The transportation facilities included in the 2025 Baseline Scenario include existing facilities and committed projects as identified by WSDOT, regional providers, and local agencies. Figure 4-10 and Figure 4-11 show the assumed highway and transit facilities added for the 2025 Baseline Scenario. Table 4-3 summarizes the major regional highway facilities added to the existing system to make up the 2025 Baseline. Highway improvements focus on the projects funded by the 2003 Nickel package. Transit improvements include an additional 350 daily bus service hours over Existing Condition levels.

Table 4-3: Roadway Projects Included in the 2025 Baseline Scenario

Facility	Project
I-90	Widening one lane from Division Street to Hamilton Street
I-90	Widening two lanes from Argonne Road to State Line
North Spokane Corridor	New roadway; Four lanes in each direction from I-90 to Francis Avenue
North Spokane Corridor	New roadway; Three lanes in each direction from Francis Avenue to US 2
North Spokane Corridor	New roadway; Two lanes in each direction from US 2 to US 395
Bigelow Gulch Road	Widening two lanes from Spokane City limit to Argonne Road

Figure 4-10: GP Lanes added to Existing in the 2025 Baseline Scenario

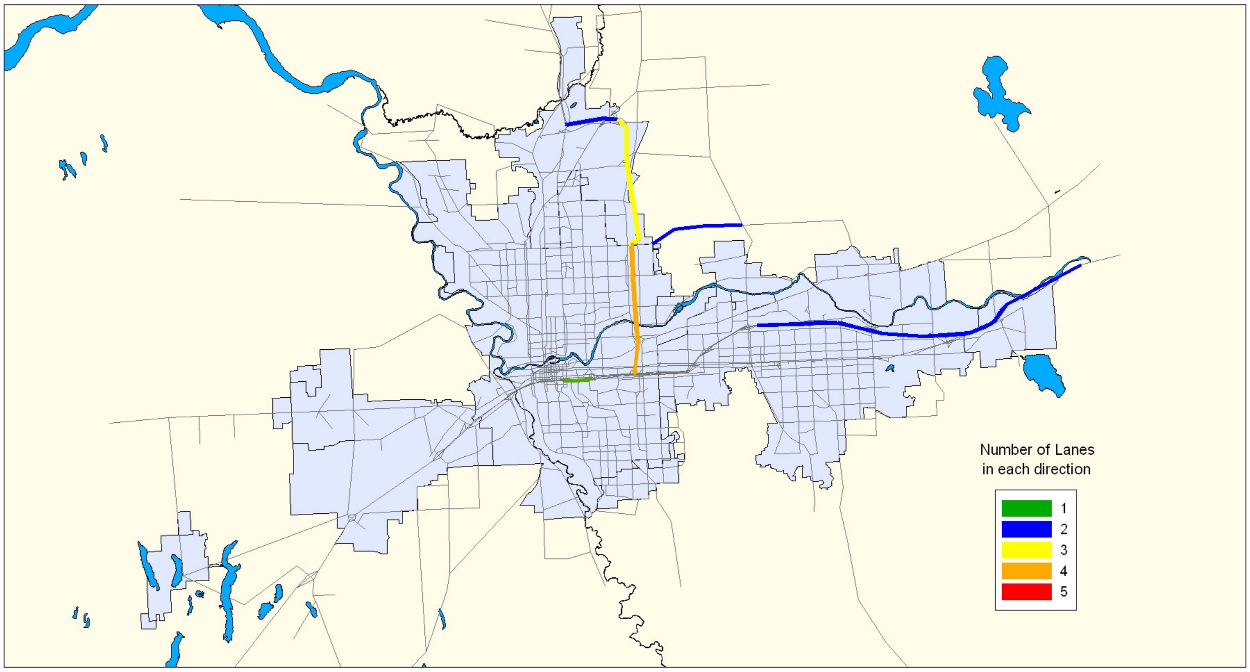
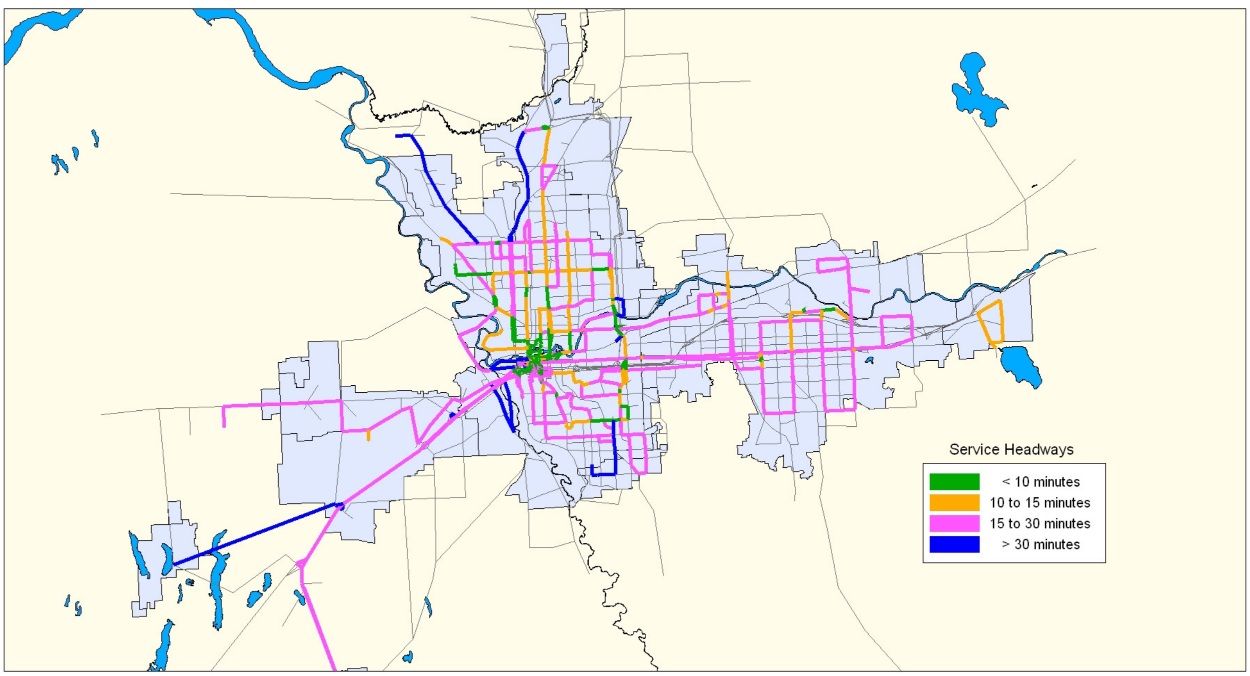


Figure 4-11: Transit Service Assumed for the 2025 Baseline Scenario



Unconstrained Demand Scenarios

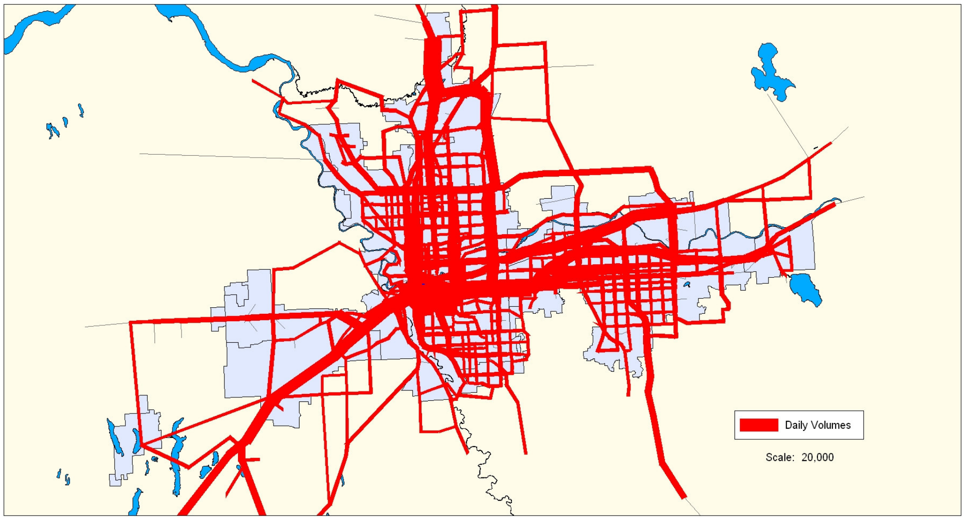
The starting point for the Congestion Relief Analysis was the unconstrained demand modeling. This point of reference helps to define where people, if given no congestion on existing facilities, would like to travel. For the Spokane area, due to the relatively low transit usage associated with low land use densities, the Spokane study team decided to perform only the unconstrained highway demand analysis.

Unconstrained Highway Demand Analysis

The Unconstrained Highway Demand Analysis assumed that travelers could make travel freely anytime within the region without encountering delay. The forecasts were run using the 2025 Baseline highway network assuming there were abundant highway capacities. Figure 4-12 shows the model results of the Unconstrained Highway Demand vs. Existing Vehicle Volumes.

Figure 4-12: Unconstrained Highway Demand vs. Existing Vehicle Volumes

The output of the Unconstrained Highway Demand model was used to help shape the Highway Focus Scenario and to compare certain key performance data. To determine the number of lanes, volume/capacity thresholds consistent with local planning principles were applied to the unconstrained vehicle volumes in the corridors. The total new lanes required to serve the unconstrained demand were then identified (see Figure 4-13).



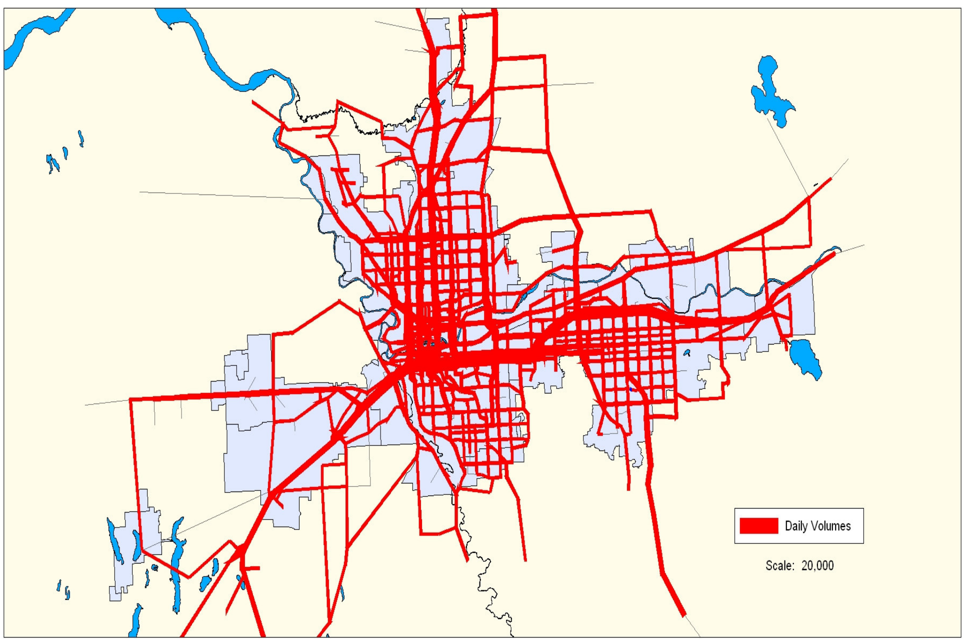
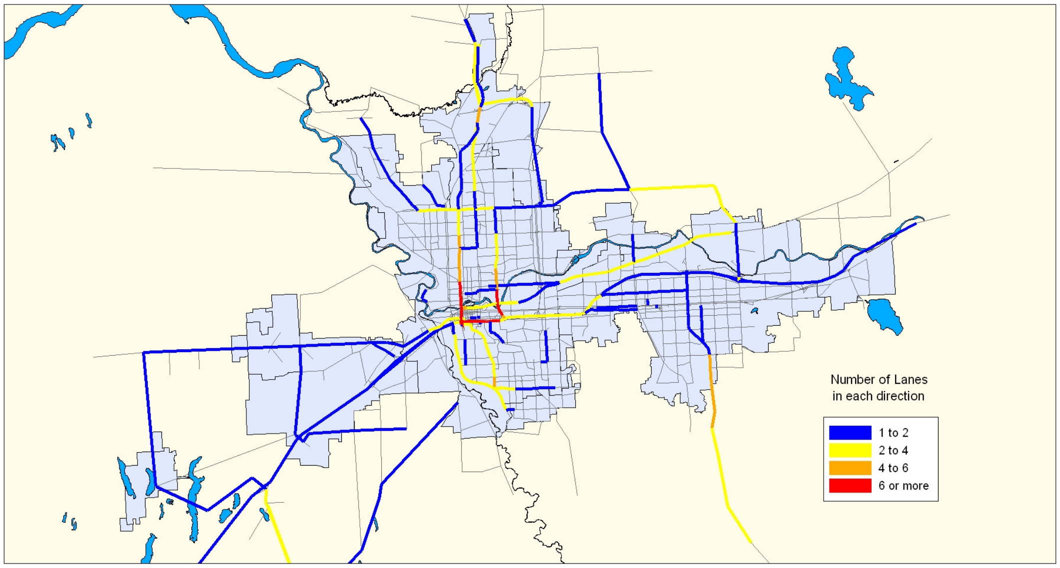


Figure 4-13: Additional Lanes Needed to Satisfy Unconstrained Highway Demand



Highway Focus Scenario

The Highway Focus Scenario included highway capacity to meet much of the unconstrained travel demand. Its purpose was to examine whether congestion could be alleviated through an aggressive road-building program. The new capacities included highway projects identified in the SRTC's Metropolitan Transportation Plan (MTP) and some additional projects to serve most of the demand revealed from the unconstrained highway capacity model run.

In the Spokane area, the Highway Focus Scenario would provide 137 more freeway lane miles and 382 more arterial lane miles than the 2025 Baseline Scenario. This represents a 25% growth in arterial lane miles, a 60% growth in freeway lane miles, and a 30% growth in total lane miles (freeway and arterial lanes combined).
Table 4-4 summarizes the lane miles added in the Highway Focus Scenario.

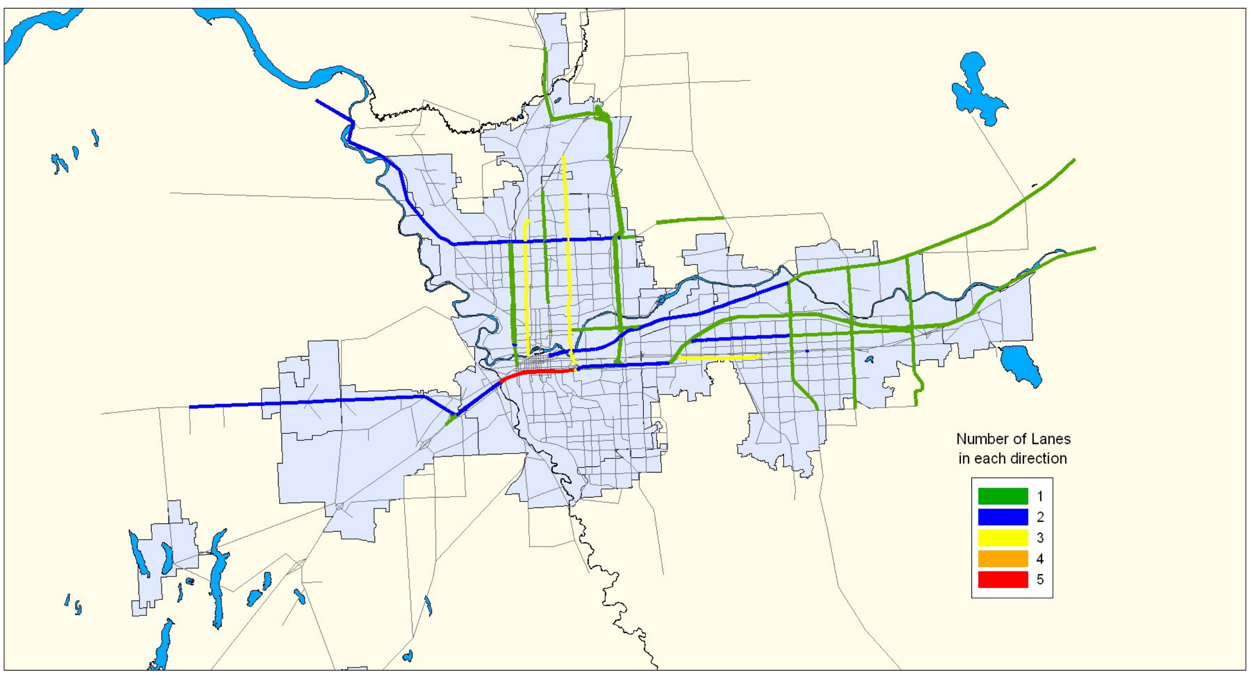
Table 4-4: Highway Lane Miles by Scenario

Scenario	**Lane Miles in Region**		
	Freeways / Expressways	*Arterials and Other*	*Total*
Existing	150	1,445	1,596
2025 Baseline	229	1,502	1,732
Lane Miles Added by Scenario	(Compared to 2025 Baseline)		
Highway Focus	+137(+60%)	+382(+25%)	+518(+30%)
Transit Focus	+11(5%)	+123(+8%)	+133(+8%)
Hwy and Transit Intensive	+115(+50%)	+302(+20%)	+399(+24%)
Highway Emphasis	+115(+50%)	+302(+20%)	+399(+24%)
Transit Emphasis	+120(+52%)	+209(+14%)	+328(+19%)
Low Highway	+120(+52%)	+209(+14%)	+328(+19%)

Figure 4-14 shows the number of general-purpose (GP) lanes added in the Highway Focus Scenario. The following are some specific locations where lanes were added:

- I-90: added between one and five lanes in each direction from US 2 to Stateline. To handle the additional capacity, a tunnel was assumed for Downtown Spokane area;
- North Spokane Corridor: added one lane in each direction from I-90 to US 395;
- US 2/395 (N. Division Street): added one lane in each direction from N. Foothills Drive to the US 2/395 Junction.
- SR 290: added two lanes in each direction from N. Division Street to SR 27 and one lane in each direction from SR 27 to Stateline;
- SR 291 (W. Francis Ave.): added two lanes in each direction from North Spokane Corridor to Rutter Parkway; and
- SR 27: added one lane in each direction from SR 290 to Belle Terre.

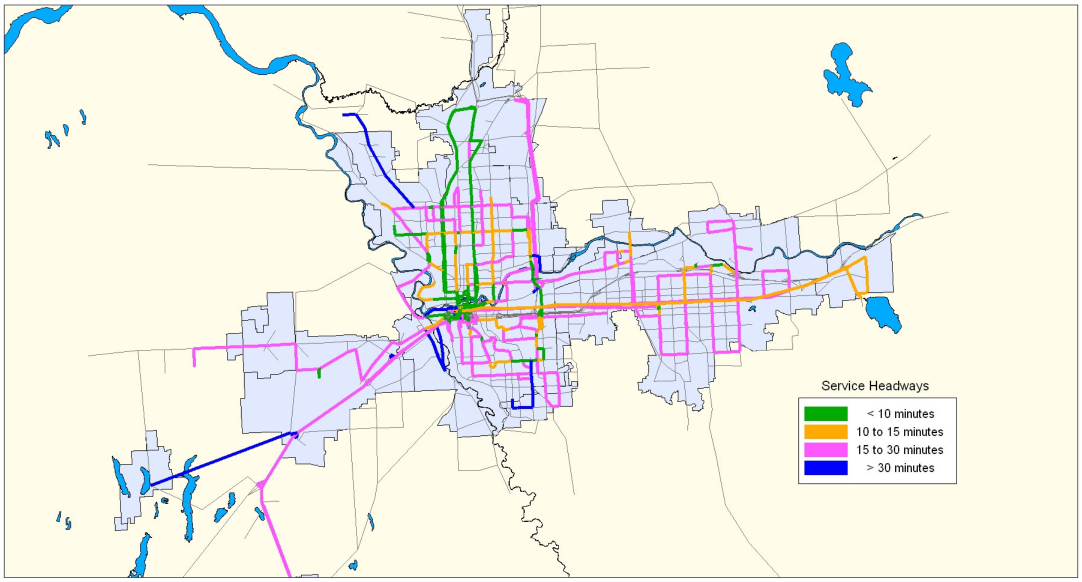
Figure 4-14: GP Lanes added to 2025 Baseline in the Highway Focus Scenario



Transit Focus Scenario

The Transit Focus builds upon previous transit planning efforts in the region. It included approximately 38% more transit service hours than in the 2025 Baseline Scenario. Transit routes and service frequencies in this scenario are shown in Figure 4-15.

Figure 4-15: Transit Service Included in the Transit Focus Scenario



The Transit Focus was developed in coordination with the Spokane Transit Authority (STA), SRTC, and WSDOT-Eastern Region. It includes equivalent of 47,000 hours additional bus service per year with the following components:

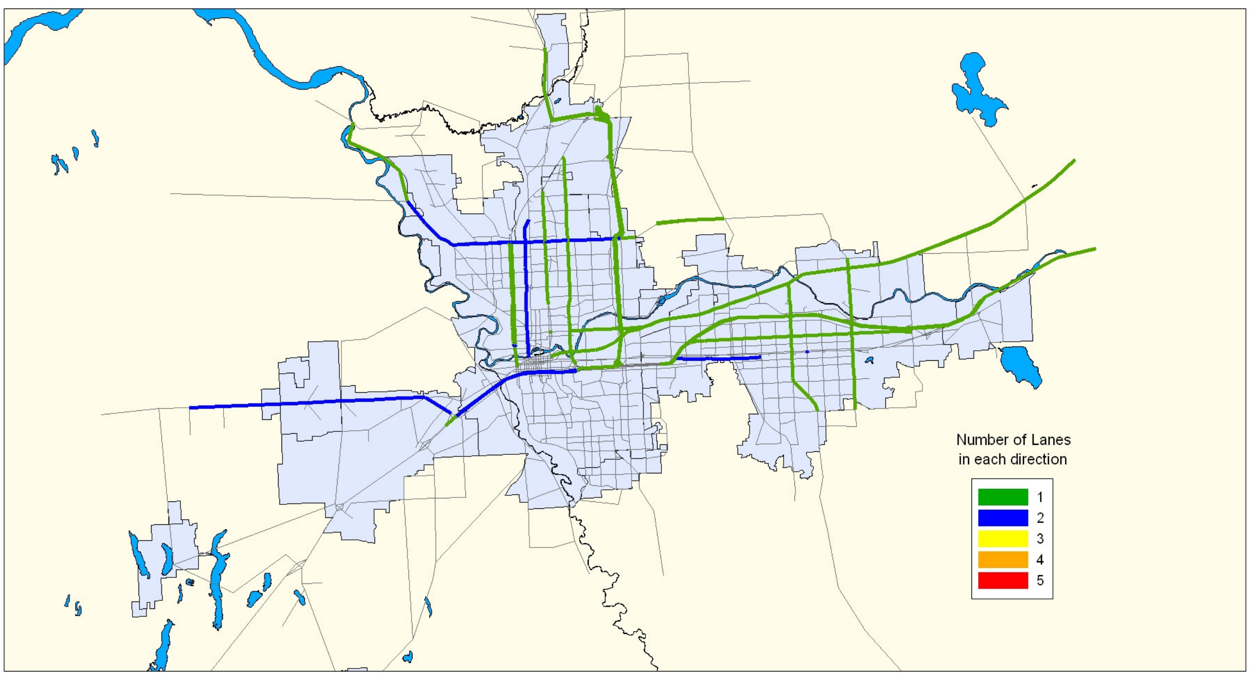
Park-and-Ride Facilities	> SR 195/Cheney-Spokane Road > Joe Albi Complex > Farwell/NSC > Francis/Market
Community Transit Centers	> Manito > Southeast Boulevard > Shadle > Northeast Community Center > Fairgrounds > Valley Transit Center
Light Rail	> South Valley Corridor from Spokane CBD to Coeur D'Alene > North Spokane Corridor from I-90 to US 395
Downtown Streetcar	> North-South Trolley Line on Howard Street from I-90 to North Central High School > East-West Trolley Lines: (1) on Boone Avenue and Division from the > Summit to Riverpoint and (2) on Riverside Avenue, 1st Avenue, Bernard > Street and Spokane Falls Boulevard from Browne's Addition to Riverpoint
Bus Rapid Transit	> Ash/Maple Streets from Hawthorne Road to I-90 > Division from Hawthorne Road to I-90 > Spokane CBD to Spokane International Airport > Spokane CBD to Cheney/EWU

Highway and Transit Intensive

The Highway and Transit Intensive Scenario combined the more productive parts of the Highway Focus with the Transit Focus Scenarios. Its purpose was to test the extent to which congestion could be relieved by investing aggressively in both highways and transit improvements. This scenario added 115 freeway and 302 arterial lane miles to the 2025 Baseline Scenario, or approximately 16% fewer freeway lane miles and 21% fewer arterial lane miles than the Highway Focus Scenario.

Table 4-4 summarizes the lane miles added in the Highway and Transit Intensive Scenario. In comparison with the Highway Focus Scenario, lanes were reduced in each direction on the following roadways: I-90 (reduced from a five-lane addition to a two-lane addition from SR 195 to Liberty Park, and reduced from a two-lane addition to a one-lane addition from Liberty Park to Sprague; SR 290 (reduced from a two-lane to a one-lane addition from N. Division Street to SR 27). Figure 4-16 shows the number of GP lanes included in the Highway and Transit Intensive Scenario. The transit element of the Highway and Transit Intensive Scenario is the same as the Transit Focus Scenario (see Figure 4-15).

Figure 4-16: GP Lanes added to 2025 Baseline in the Highway Emphasis and Highway and Transit Intensive Scenarios



Highway Emphasis

The Highway Emphasis Scenario had the same level of highway investment as described in the Highway and Transit Intensive Scenario, but it included no additional transit services over the 2025 Baseline Scenario. The GP lane additions are shown in Figure 4-16.

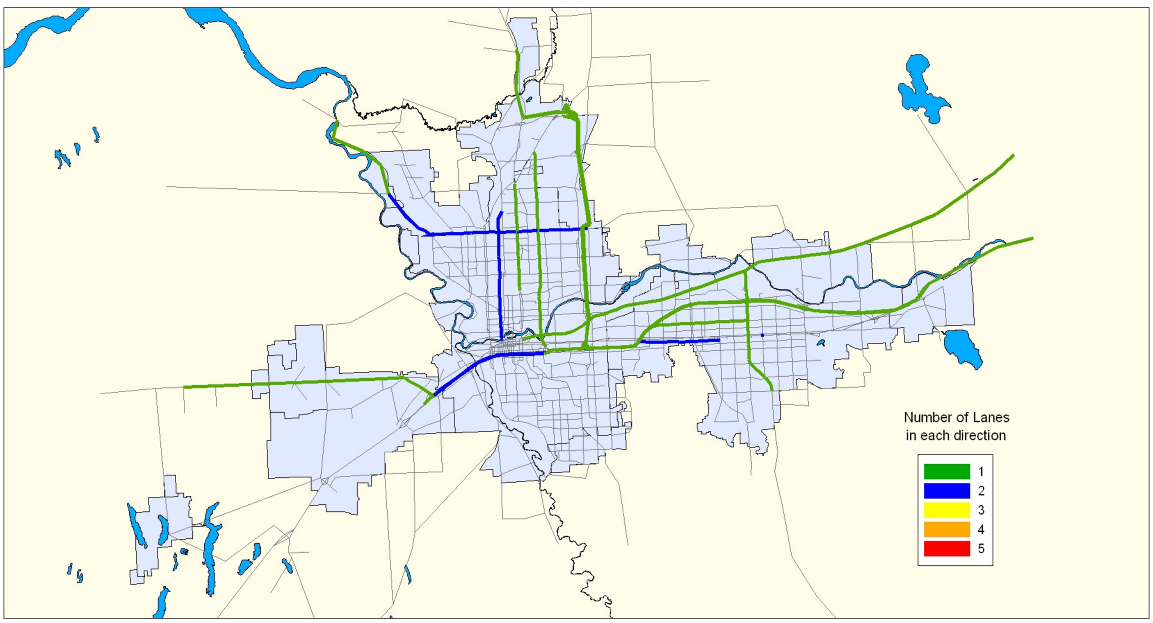
Transit Emphasis

The Transit Emphasis Scenario included the same level of transit investment as described for the Transit Focus Scenario, but it had a lower level of highway investment. Its purpose was to test the degree to which lowering the level of highway infrastructure affects congestion levels, while keeping the transit investment fixed.

This scenario included an additional 120 freeway and 209 arterial lane miles, as compared with the 2025 Baseline Scenario. The GP lanes added in this scenario are shown in Figure 4-17. About 95% of the lane miles were added directly within the region's urban growth area. Virtually all of the additional lane miles in this scenario would provide additional capacity to serve the outlying growth areas, providing improved access to the urban core area.
Table 4-4 on page 4-17 summarizes the lane miles added in the Transit Emphasis Scenario.

Specific highway capacity additions included the following: I-90 (added two lanes in each direction from US 2 to SR 195 and one in each direction from Sprague to Stateline; US 2 (added one lane in each direction from Fairchild AFB to I-90); SR 290 (added one lane in each direction from Division Street to Stateline); SR 291 (added two lanes in each direction North Spokane Corridor to Rutter Parkway); Division Street ("Y" to North Foothills Drive), and SR 27 (added one lane in each direction from SR 290 to Belle Terre). Overall, the highway investment represents approximately 63% of the lanes added in the Highway Focus Scenario.

Figure 4-17: GP Lanes Added to 2025 Baseline in the Transit Emphasis Scenario



Low Highway

The Low Highway Scenario contained the same level of highway investment as was assumed in the Transit Emphasis Scenario, which was the lowest level of highway investment tested for all build scenarios. On the transit side, it assumed no transit service increase over the 2025 Baseline Scenario.

4.5 Evaluation Results

Transportation Analysis Metrics

A series of transportation analysis metrics was developed to assess the comparative performance of the scenarios in terms of their effectiveness in addressing congestion. Table 4-5 lists the analysis metrics chosen to compare performance among the scenarios.

Table 4-5: Transportation Analysis Metrics

Analysis Metric	Definitions
Vehicle Hours of Delay	The amount of delay (per vehicle) experienced either daily or during the three-hour PM peak period.
Commercial Vehicle Hours of Delay	The amount of delay experienced by trucks either daily or during the three-hour PM peak period.
Vehicle Delay per Mile	The intensity of delay experienced by vehicles on the state highway system measured as total daily delay per mile.
Congested Hours per Day	The number of hours per day during which a corridor is congested in the peak direction of travel.
Travel Times	The time it takes to travel, either via car or transit, during the PM peak period for a set of typical trips in the region.
Person Volumes	The number of people traveling on a facility during a day or during a three-hour peak period.
Vehicle Miles of Travel	The number of miles all vehicles travel either for an entire day or during the PM peak period.
Mode Share	The number of people traveling by transit (for all trips, and for work trips only) averaged for an entire day.

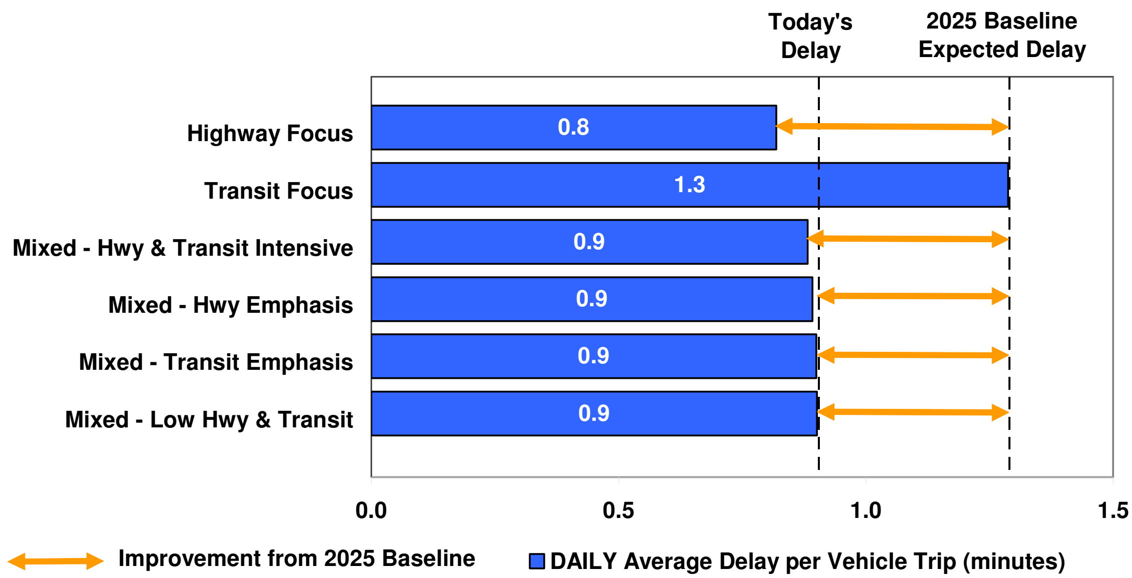
Vehicle Hours of Delay (VHD) and Delay per Vehicle Trip

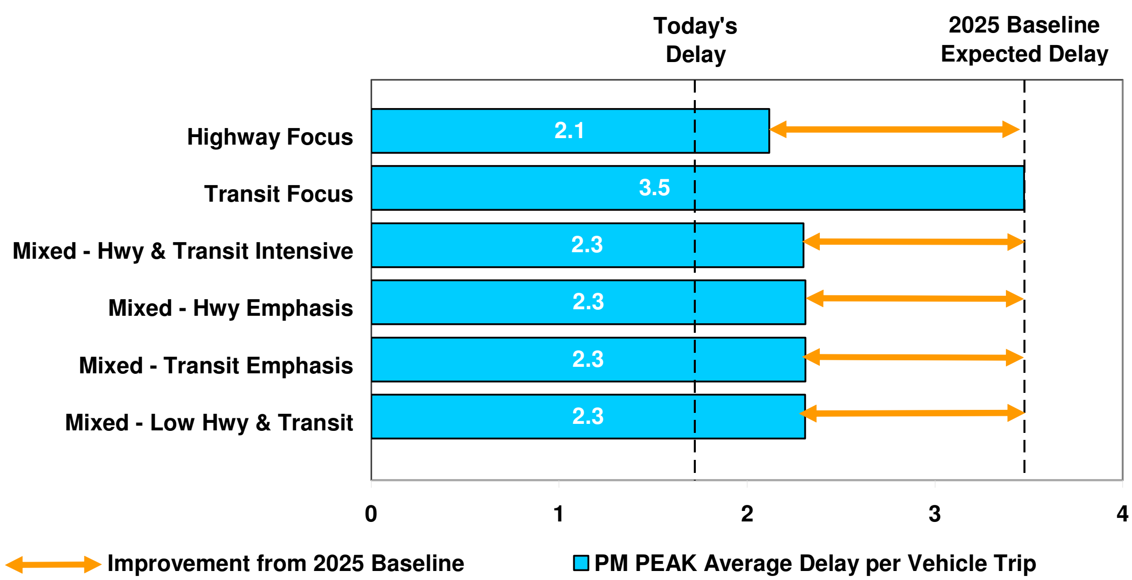
Vehicle hours of delay measures the delay experienced by vehicles. There are two metrics used: 1) average delay per vehicle, which provides the average time delay for each vehicle trip generated in the region during the day and during the PM peak period, and 2) total vehicle hours of delay, which measures the daily and PM peak period delay experienced by all vehicles. Delay is defined as the difference between highway speed when traffic is operating at free flow conditions (typically near or at the speed limit) and the speed resulting from the traffic conditions in the scenario being modeled.

Average Delay per Vehicle Trip

A comparison of modeled average daily and PM peak period delay per vehicle trip for all scenarios is shown in Figure 4-18. The average delay per vehicle trip during the PM peak period, currently at 1.7 minutes, would more than double to 3.5 minutes for the 2025 Baseline Scenario. The Highway Focus Scenario would reduce the average PM peak delay to 2.1 minutes, which is 39% lower than the 2025 Baseline and 23% higher than existing delay. All of the other scenarios had delays of about 2.3 minutes, which is about 34% lower than the 2025 Baseline, and about 34% higher than existing.

Figure 4-18: Average Delay per Vehicle Trip



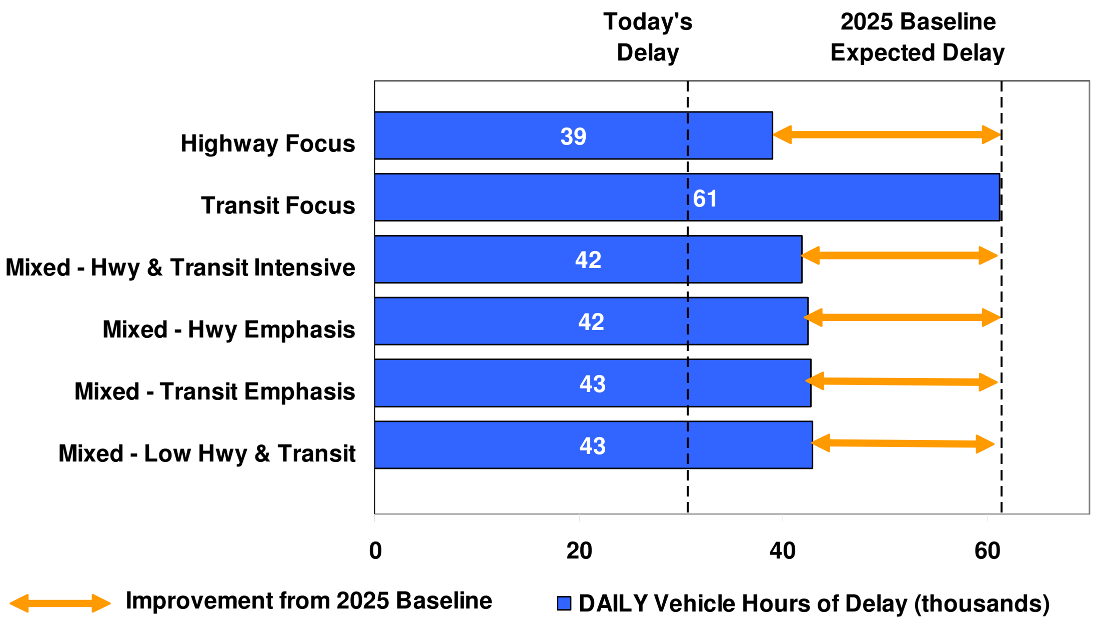


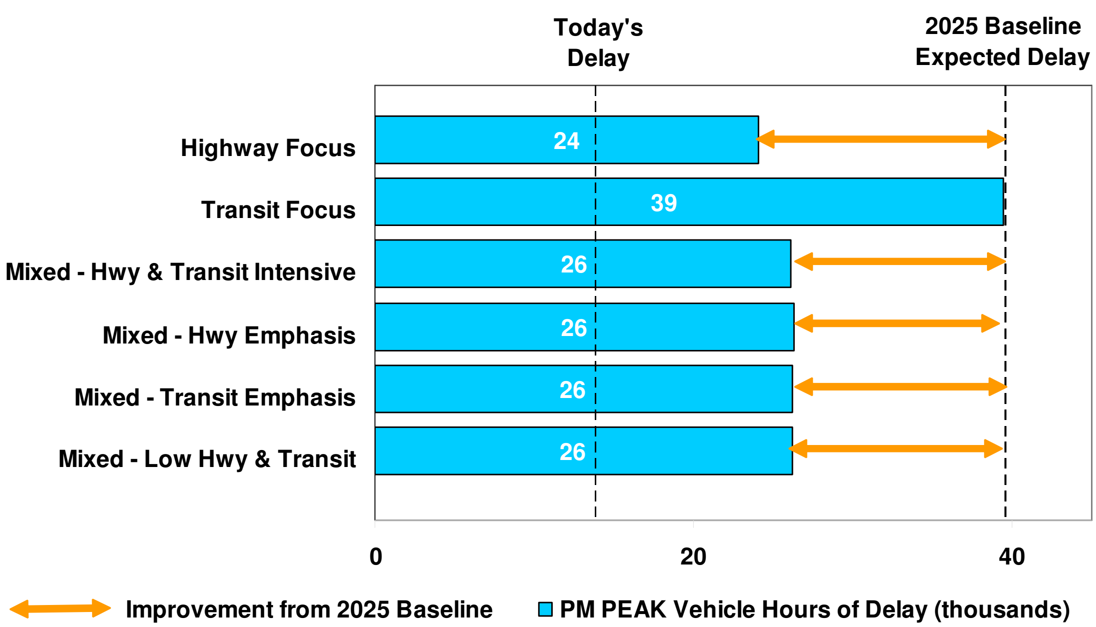
Total Vehicle Hours of Delay

A comparison of total daily and PM peak period vehicle delay for all scenarios is shown in Figure 4-19. In the 2025 Baseline Scenario, the daily total vehicle delay would increase by just over

100% as compared to existing conditions. The Highway Focus Scenario would reduce daily total vehicle delay by about 58% compared to the 2025 Baseline, but still 27% higher than existing total vehicle hours of delay. The four other scenarios would reduce delay slightly less than the Highway Focus Scenario (by 43 to 47% compared to 2025 Baseline). During the PM peak period, the delay for all scenarios would reflect the same trends as shown for daily.

Figure 4-19: Total Vehicle Hours of Delay



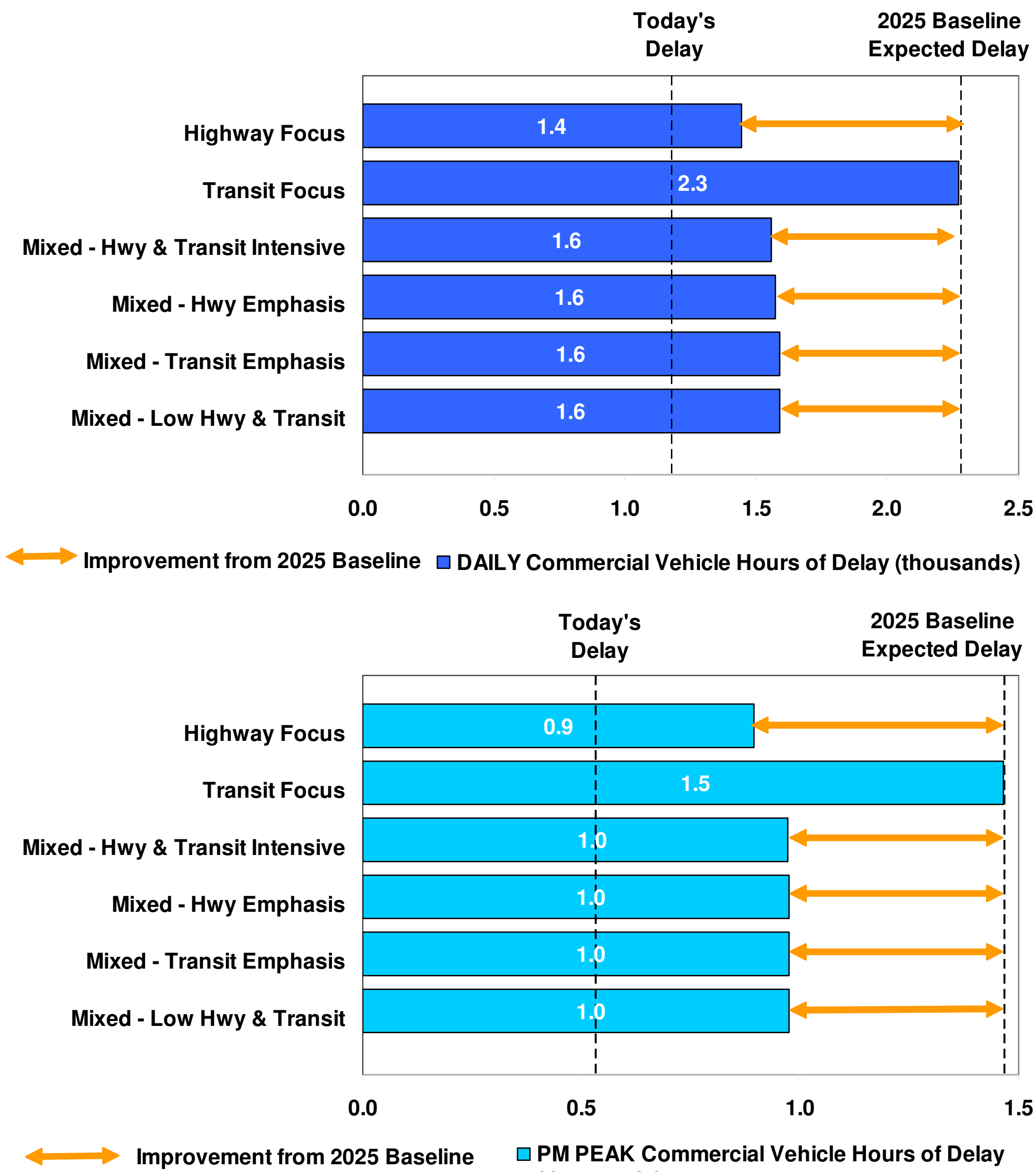


Commercial Vehicle Hours of Delay (daily)

Figure 4-20 summarizes the commercial vehicle hours of delay for each scenario. Commercial vehicle delay closely tracks the trends for GP traffic shown in Figure 4-19. In the 2025 Baseline

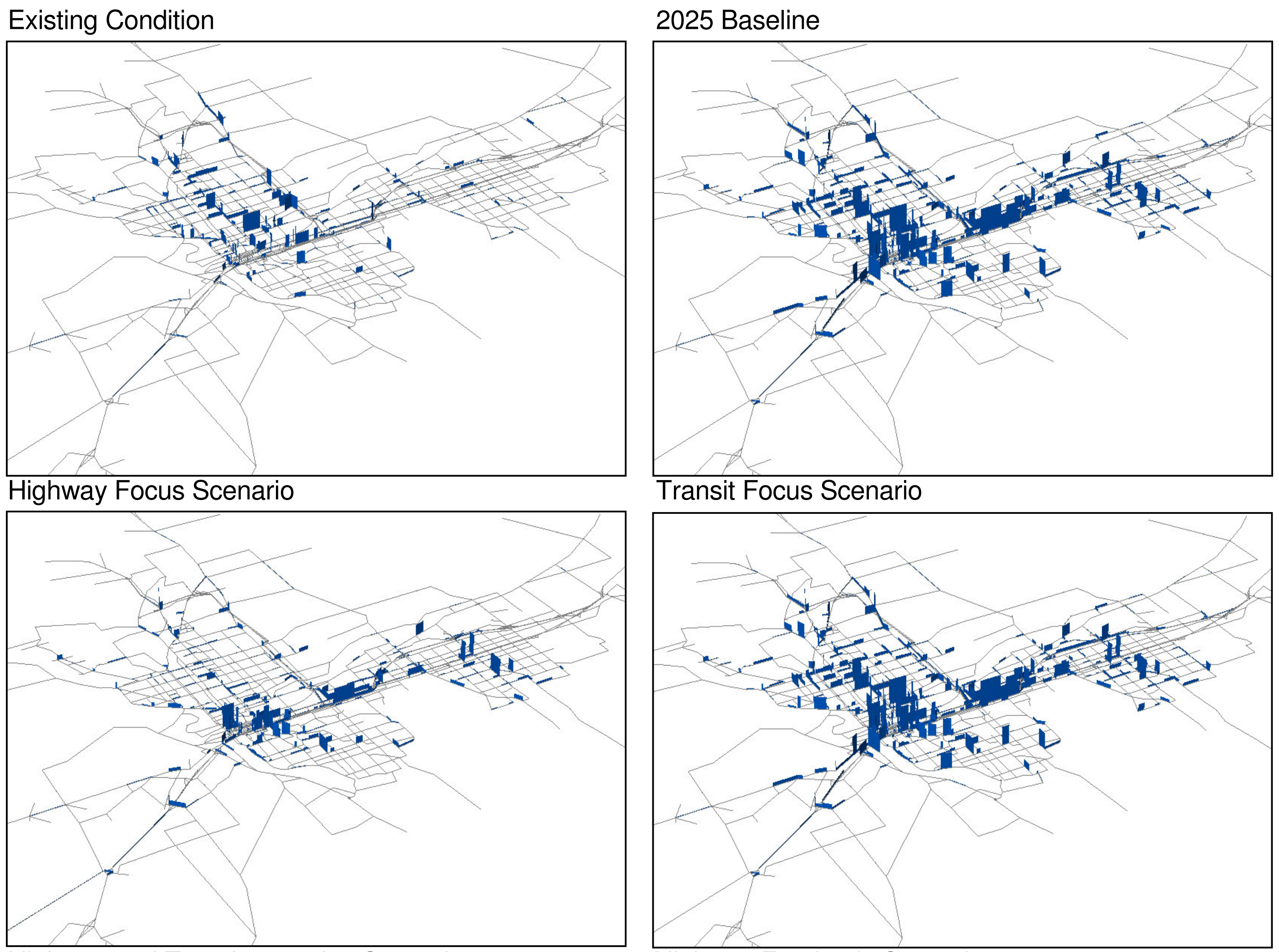
Scenario, total daily commercial vehicle hours of delay would increase by about 94% compared to existing conditions. The Highway Focus Scenario reduces commercial vehicle delays by 58% compared to the 2025 Baseline, while the other scenarios reduce commercial vehicle delay by 43 to 46%, with the Highway and Transit Intensive, and Highway Emphasis Scenarios performing slightly better than the Transit Emphasis and Low Highway Scenarios. During the PM peak period, the hours of delay for all scenarios would reflect the same trends as shown for daily.

Figure 4-20: Commercial Vehicle Hours of Delay

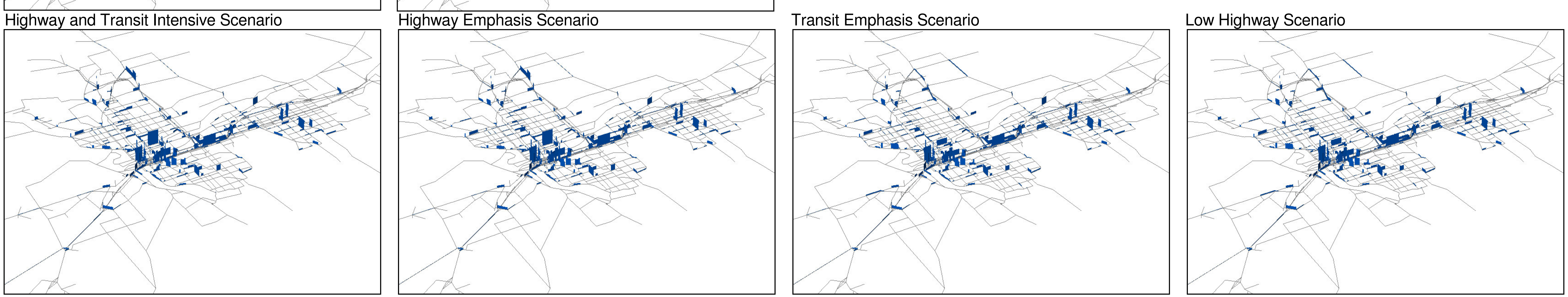


Vehicle Delay per Mile

Figure 4-21: Delay per Mile on State Highways and Interstate Freeways



Vehicle delay per mile provides a metric of congestion intensity that can be examined on a corridor or segment basis. Figure 4-21 shows total daily delay per mile on the state highway system in the Spokane area. As seen in the first row, delay per mile is expected to increase substantially on most highways from now until 2025 in the baseline condition. The model predicted that the greatest delay would occur in the central portion of the region, especially along I-90. The second row shows the results of the two scenarios focused on single modes. The Highway Focus Scenario would reduce delay per mile to a level that is similar to existing conditions. The Transit Focus Scenario shows little improvement in delay compared with the 2025 Baseline condition. The third row shows the four other scenario results.



Congested Hours per Day

Another way to measure congestion is to look at the number of hours per day during which a roadway is congested. In this study, congestion is based on the use of a volume-to-capacity ratio-based calculation applied to the peak travel periods that is converted into total hours of delay for each study corridor. In essence, the higher the V/C ratio, the greater the total hours of delay produced. A more complete description of the method for calculating congested hours per day can be found in Chapter 2, Study Methodology.

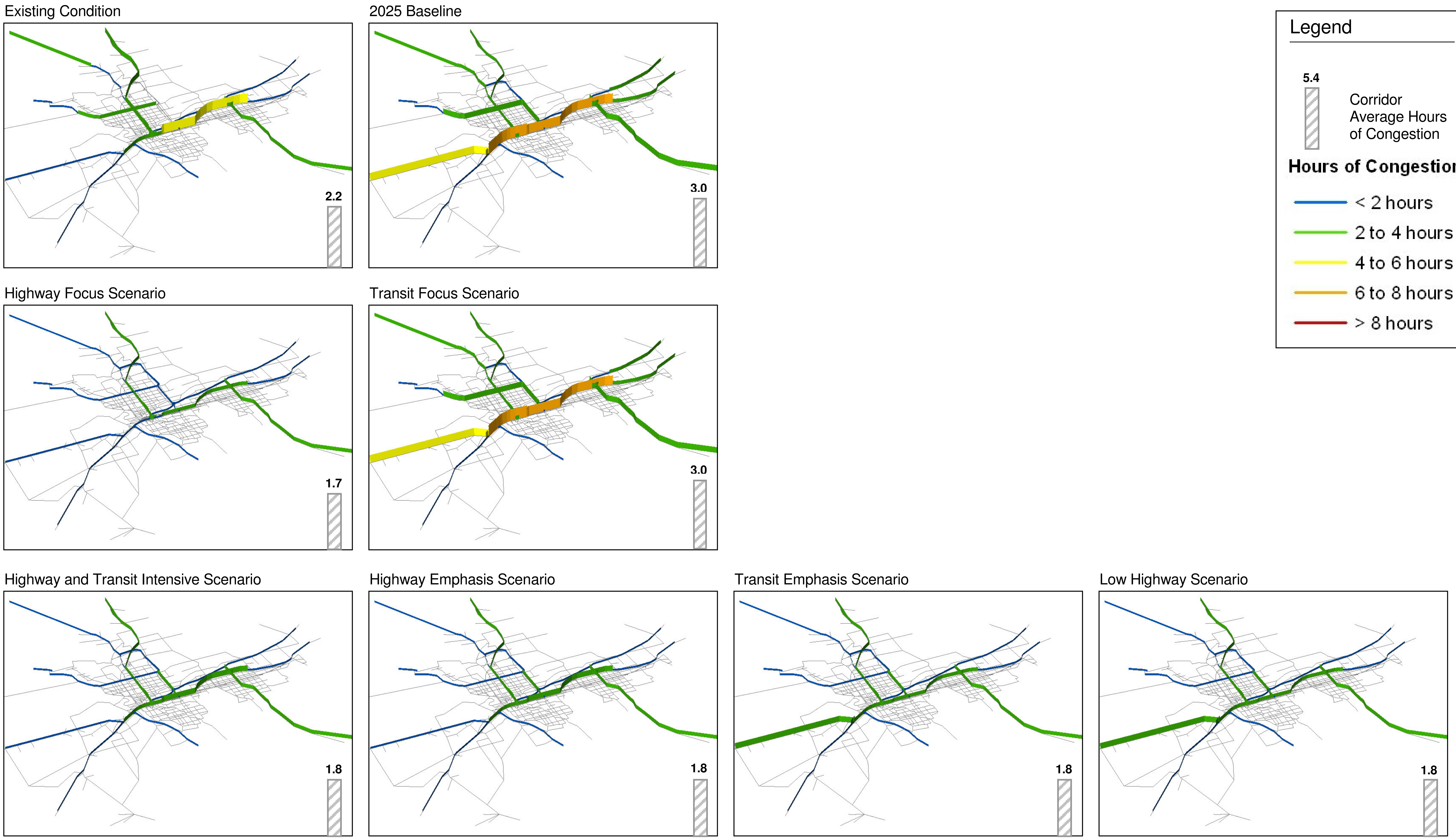
Congestion was measured along the major highway facilities within each of the 16 study corridors. The set of maps in Figure 4-22 illustrates the duration of traffic congestion that exists today and the congestion levels that are forecast for each scenario.

The first row compares existing congestion with 2025 Baseline. Currently, most corridors in the Spokane area show short periods of congestion, on average approximately two hours per day. The most congested facilities are I-90, and US 395/US 2/Division Street. By 2025, traffic flows in all corridors are expected to deteriorate, with corridors experiencing an average of about three hours of congestion during the day. Much of the growth in congestion is evident in the outlying areas of the Spokane area: US 2 west of I-90, SR 290 from Sullivan Road to the Idaho State Line, and SR 27.

The second row *shows the two focus scenarios. The Highway Focus Scenario improves congestion duration to levels similar to existing conditions.* Corridors that would benefit most from the Highway Focus Scenario investments include I-90 through downtown Spokane and Spokane Valley, US 395 from the US 2 junction to Stevens County, US 2 west of I-90, and SR 290 from Sullivan Road to the Idaho State Line. SR 27, a corridor with few available alternative routes, showed minimal improvements in congestion. The Transit Focus Scenario does not show any changes in congestion duration compared to the 2025 Baseline.

The third row shows the results of the other scenarios. The Highway and Transit Intensive Scenario and the Highway Emphasis Scenario would improve corridor congestion levels to levels similar to existing conditions, but slightly higher than with the Highway Focus. Corridors that would benefit the most include I-90 through downtown Spokane, US 395 from the US 2 Junction to Stevens County, US 2 west of I-90, and SR 290 from Sullivan Road to the Idaho State Line. Although the Transit Emphasis Scenario and the Low Highway Scenario scenarios would reduce congestion compared to 2025 Baseline, the computer model predicted that congestion levels under these scenarios would be higher than existing conditions.

Figure 4-22: Congested Hours per Day



Origin-Destination (O-D) Travel Times

Major activity centers were chosen as origins and destinations for determining point-to-point travel times during PM peak period. As shown in Figure 4-23, origins include downtown Spokane and West Spokane (I-90/US 195 Interchange), while destinations include Spokane International Airport, Idaho State Line, North Spokane (Northpointe Shopping Center), Liberty Lake, Stevens County and South Spokane (Hatch Road). Table 4-6 shows the point-to-point travel times for general-purpose traffic.

Figure 4-23: Selected Commuter Routes in the Spokane Area

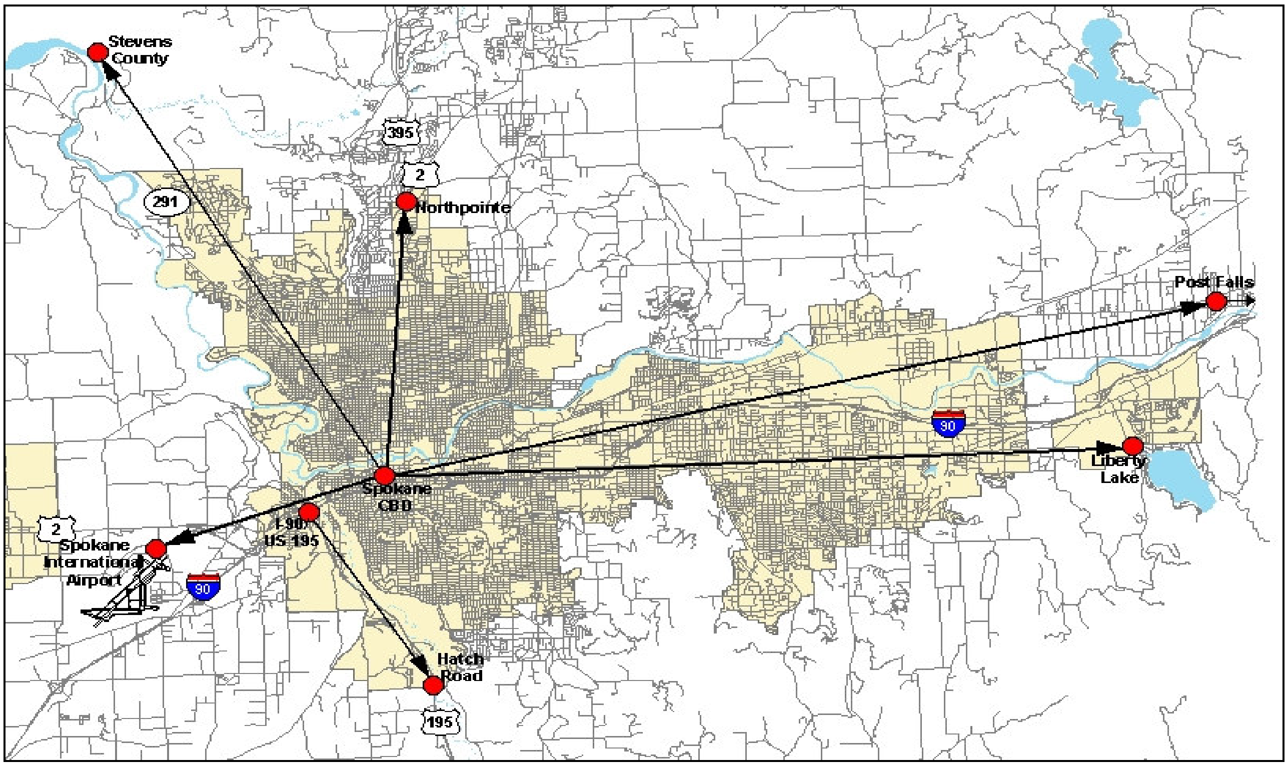
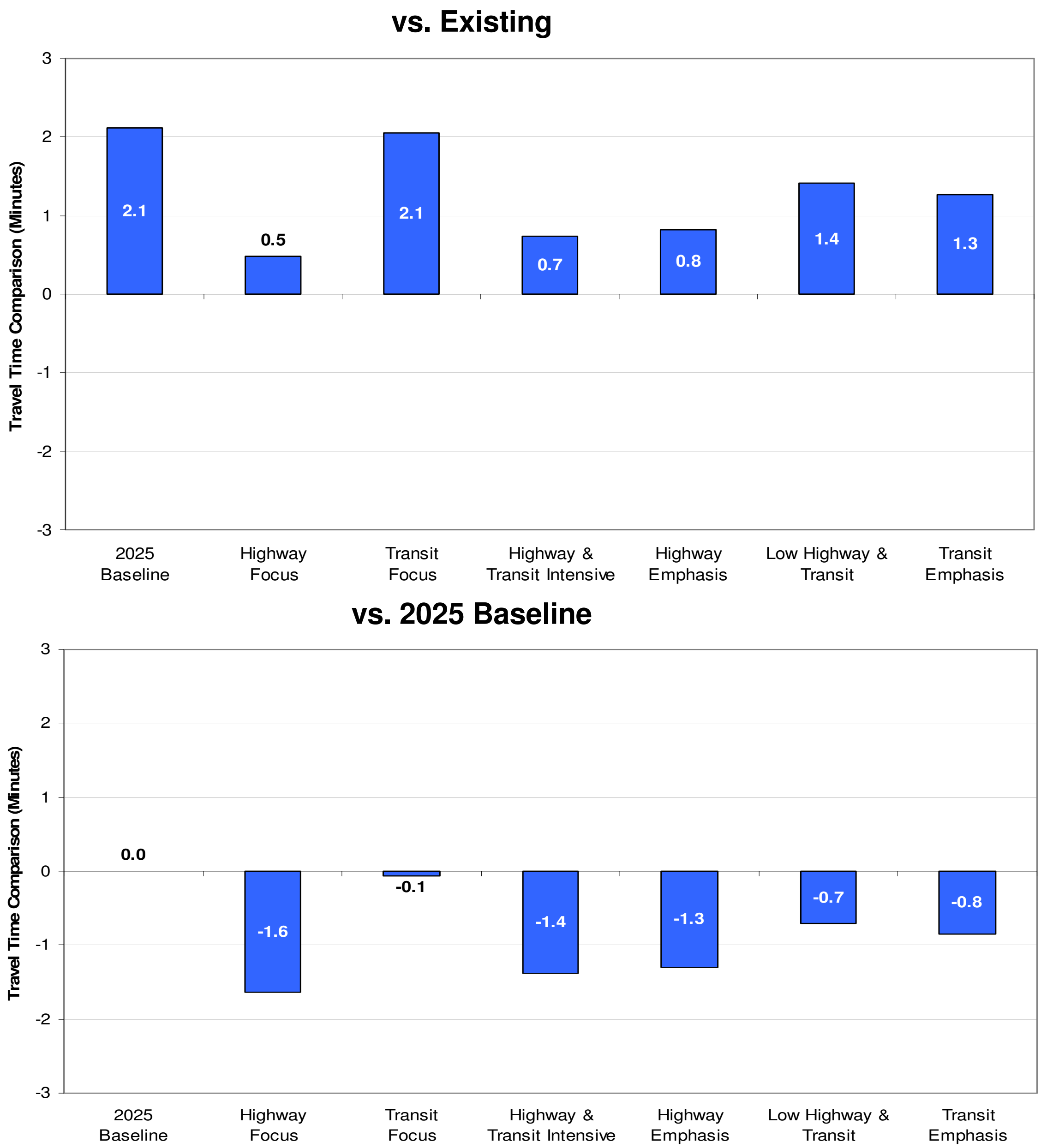


Table 4-6 Point-to-Point Travel Time for General-Purpose Traffic (Three-Hour PM Peak Period)

Commuter Route	Existin g	2025 Baseline	Highway Focus	Transit Focus	Highway & Transit Intensive	Highway Emphasis	Low Highway	Transit Emphasis
CBD to Airport	7.3	8.3	7.6	8.2	7.8	7.9	8.0	8.0
CBD to Post Falls	24.8	31.4	25.6	31.4	25.9	25.9	27.9	27.6
CBD to northpointe	11.2	11.6	11.2	11.5	11.2	11.4	11.6	11.5
US 195 at I-90 to Hatch Road	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Sprague Avenue to Liberty Lake	22.3	25.9	24.1	25.8	24.7	24.8	25.6	25.2
CBD to Stevens County	21.8	22.9	21.8	22.8	22.2	22.3	22.7	22.7
Overall Average for 6 Routes	*15.5*	*17.6*	*16.0*	*17.5*	*16.2*	*16.3*	*16.9*	*16.8*

Figure 4-24 shows the average highway travel time savings for all six point-to-point routes in relation to the Existing and 2025 Baseline Scenarios. With 2025 Baseline, the average travel times for evening peak hour trips along these selected routes are expected to increase by as much as 27% by 2025. For example, travel from downtown Spokane to Post Falls (Idaho) during the PM peak period currently takes approximately 25 minutes, and by 2025 it is expected to take 31 minutes. Going from downtown Spokane to Liberty Lake, an 18-mile trip is forecasted to take 26 minutes in 2025 compared with 22 minutes currently.

Figure 4-24: Average PM Peak Period GP Travel Time Comparisons for Selected Routes[5]



[5] Based on the six commuter routes defined in Table 4-6.

For GP traffic traveling on these routes, the Highway Focus Scenario would save, on average, 1.6 minutes of travel time compared to the 2025 Baseline Scenario. When a high level of highway investment is joined with transit investment (i.e., Highway and Transit Intensive Scenarios), the travel time savings would be nearly the same, approximately 1.4 minutes. These travel times are slightly higher than existing times. The Transit Emphasis Scenario would achieve approximately half of these time savings. Overall, the travel time benefits along these specific corridors are greater than the system-wide average delay savings.

Person Volumes Compared to Unconstrained Highway Demand

Person volumes were compared among scenarios at several locations throughout the Spokane area. The purpose was to assess how well each scenario would serve the potential travel demands in 2025. To accomplish this, model projected person volumes across certain screenlines were recorded and compared to the "capacity-unconstrained demand" obtained from the capacity unconstrained model run (Figure 4-12). Screenlines are imaginary lines drawn across several parallel roadways and other transportation facilities, and are used as a reference point for reporting travel volumes (Figure 4-25).

Figure 4-25: Spokane Area Screenline Locations

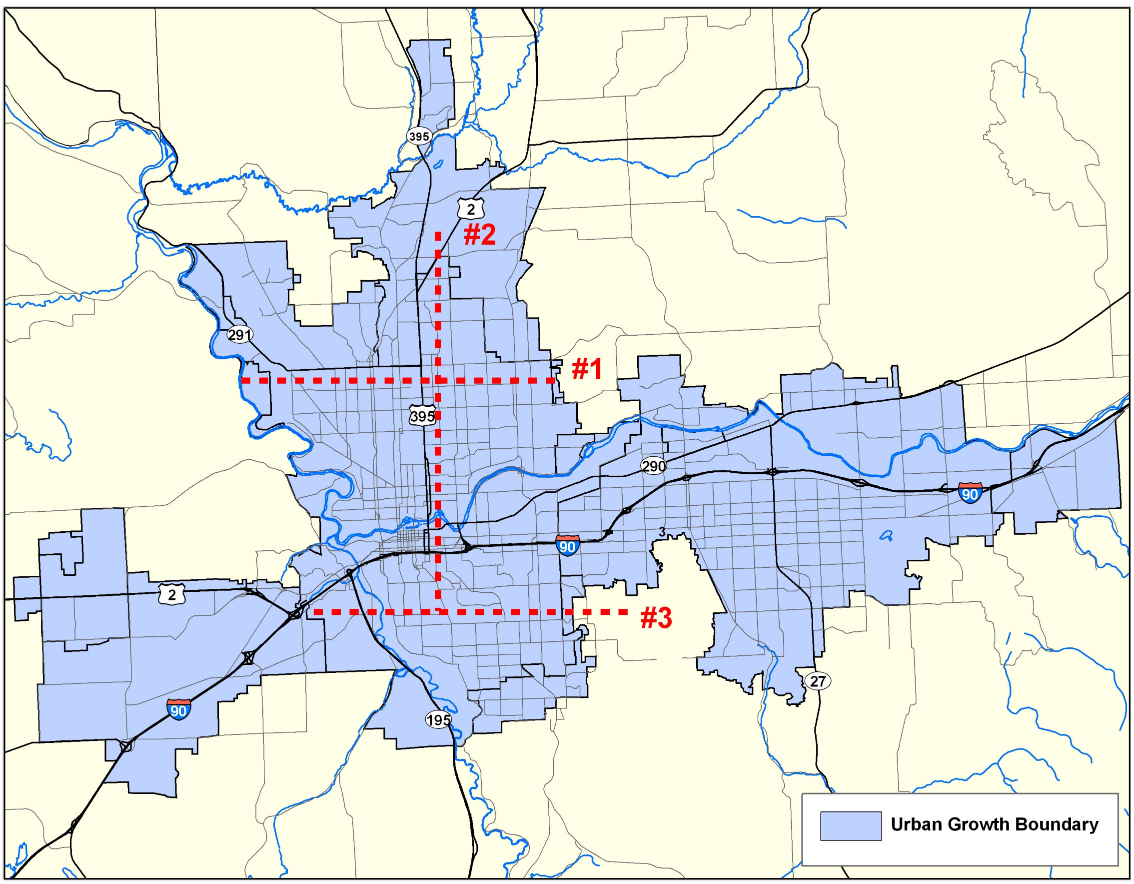
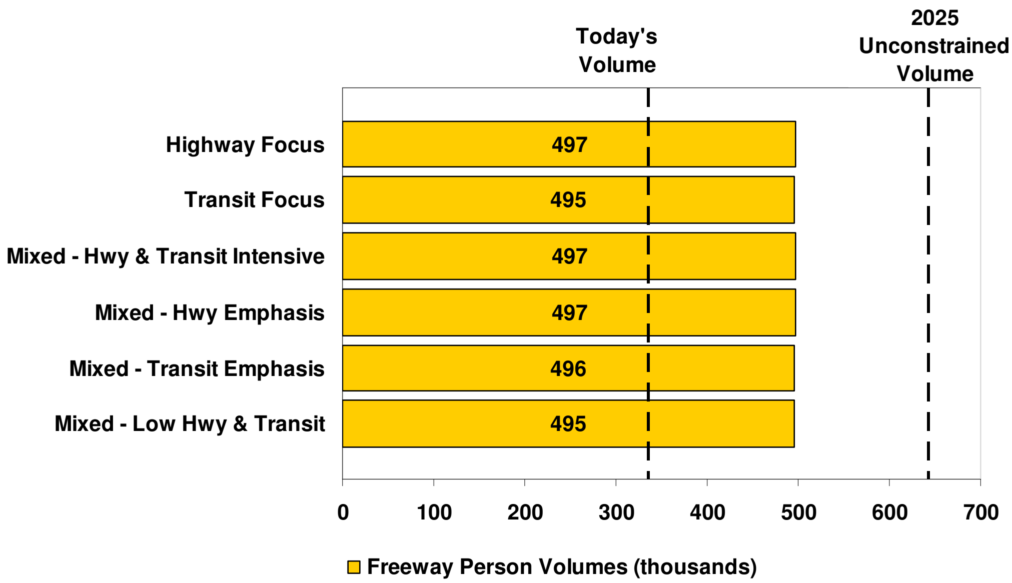


Figure 4-26 through Figure 4-28 compare the person volumes at three screenlines. The Highway Focus Scenario would accommodate approximately 81% of the unconstrained demand at the screenlines. The Transit Focus Scenario would accommodate approximately 80% of the unconstrained demand. The other scenarios show results that fall within this tight range.

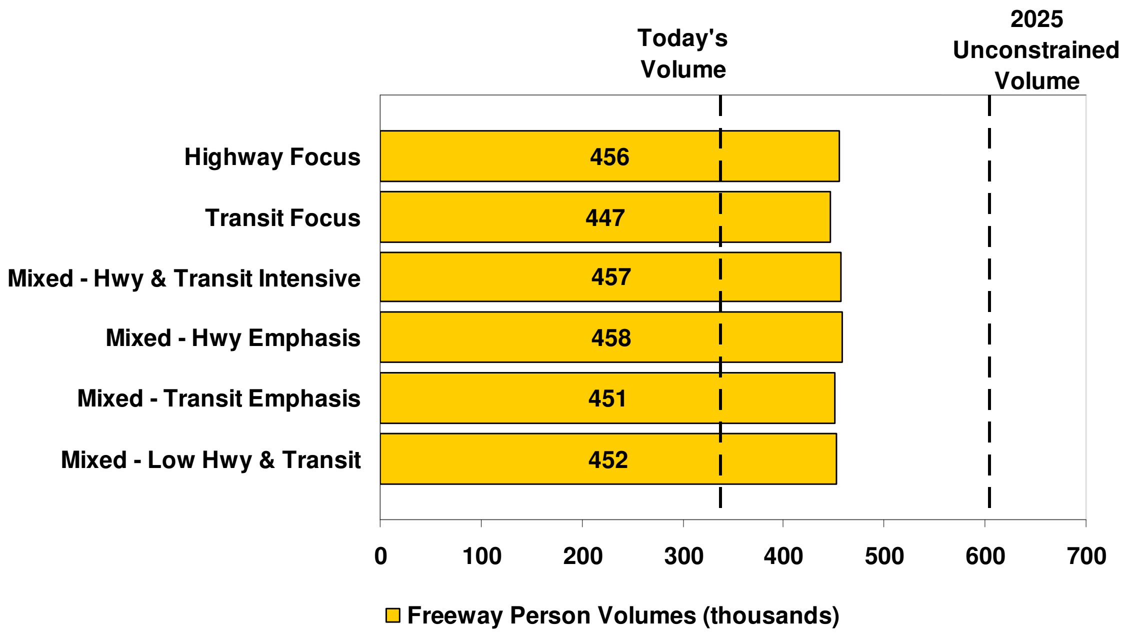
Screenline 1: Francis Avenue from Nine Mile Road to Argonne Road – This screenline was used to analyze north-south travel for roadways in the area north of the downtown area along Francis Avenue (SR 291). This screenline helps to describe travel demand between the north residential/ rural areas of Spokane County and downtown Spokane. The total daily person trips for all scenarios were fairly consistent, regardless of the level of roadway or transit investment. The relative balance can be attributed to a high number of alternate arterials, from which travelers could choose. The demand served by these scenarios represents up to 77% of unconstrained demand.

Figure 4-26: Daily Person Volumes – Francis Avenue from Nine Mile Road to Argonne Road (Screenline 1)



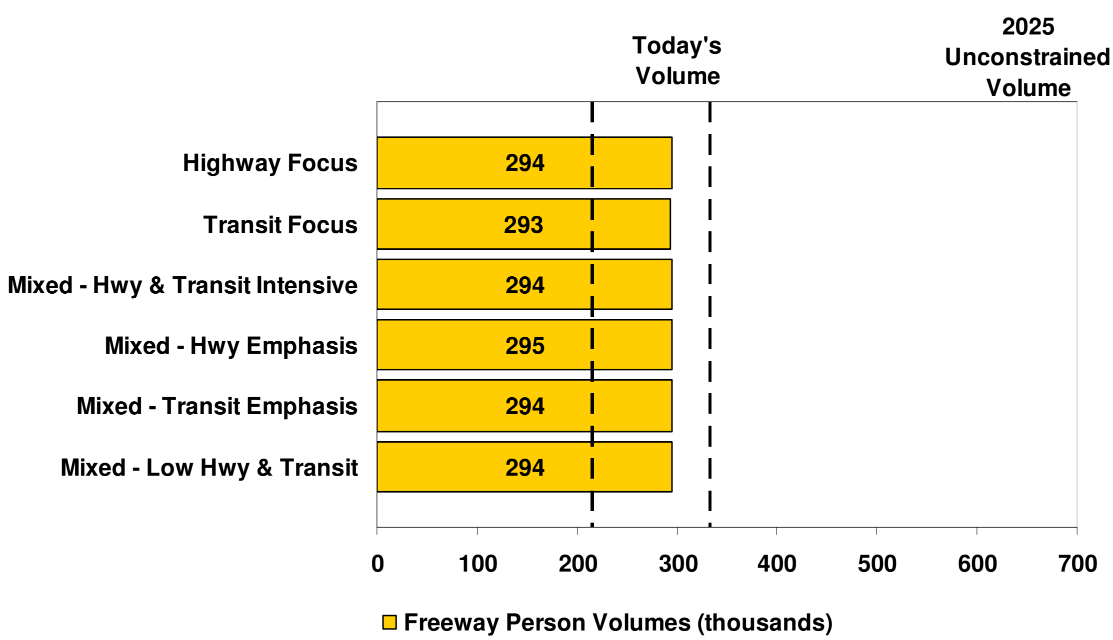
Screenline 2: Division Street from Hawthorne Road to Sharp Avenue – This screenline was used to analyze east-west travel through the north central portion of the region, primarily those trips north of the downtown area. Major east-west arterials that cross this screenline include SR 291, E. Wellesley and E. Empire. The scenarios with the highest levels of roadway investment would serve the most daily person trips (up to 76% of unconstrained demand). Those with lower investments in roadways, such as the Transit Focus Scenario and the Transit Intensive Scenario would serve the fewest trips at this screenline location.

Figure 4-27: Daily Person Volumes – Division Street from Hawthorne Road to Sharp Avenue (Screenline 2)



Screenline 3: 29th Avenue from High Drive to Glenrose Road – This screenline was used to analyze north-south travel for roadways south of the downtown area. All of the scenarios, as projected by the model, would serve nearly 90% of the unconstrained demand. The lack of variation among the scenarios can be attributed to the fact that no facility improvements were assumed in this area of the model network.

Figure 4-28: Daily Person Volumes – 29th Avenue from High Drive to Glenrose Road (Screenline 3)

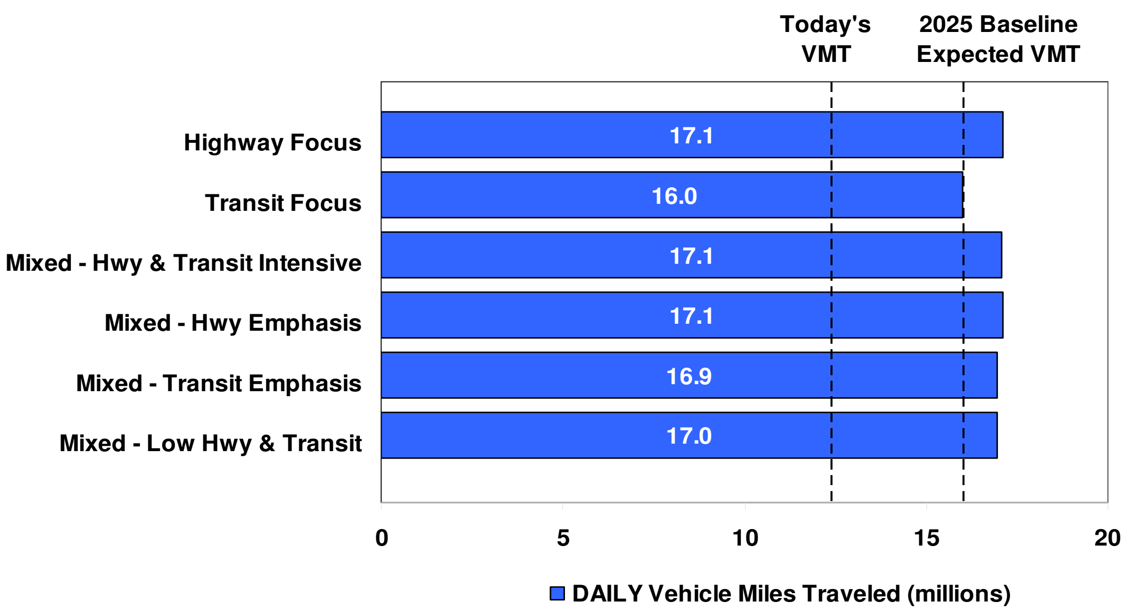


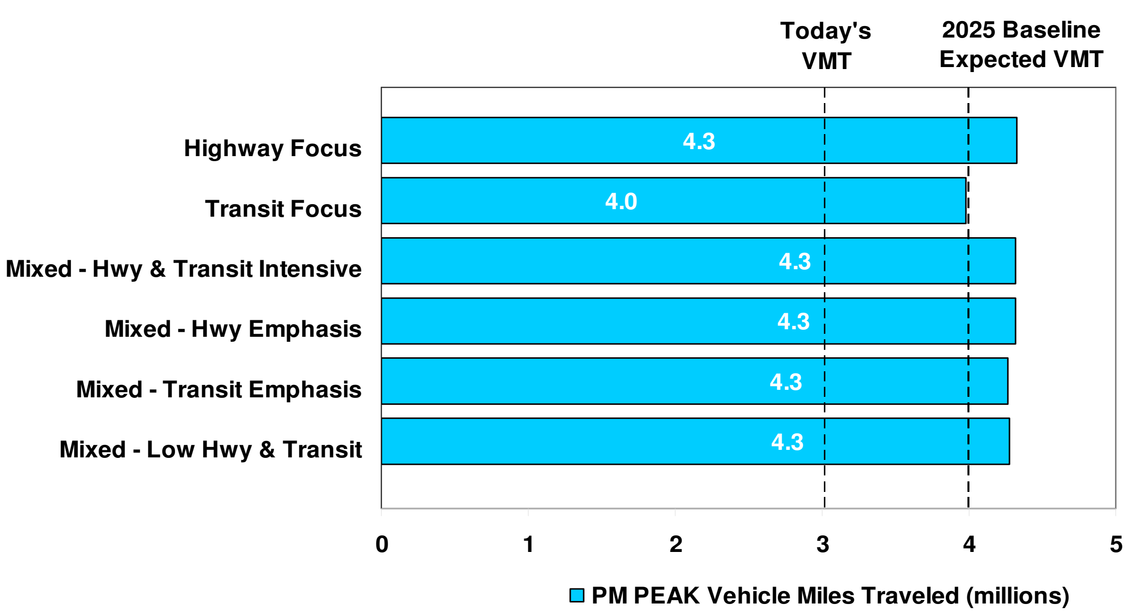
Vehicle Miles Traveled

Vehicle miles of travel (VMT) is a metric of total vehicle trips per day multiplied by the length of the trip (in miles). VMT was summarized at the regional level and portrays overall changes in travel activity that may occur in response to a scenario.

Figure 4-29 summarizes the changes in regional VMT during the daily and PM peak period. Within the region, daily VMT is forecast to increase nearly 29% in the 2025 Baseline Scenario. As compared with today's daily VMT, the increase ranges from 37% for the Transit Emphasis Scenario to 39% for the Highway Focus Scenario. The growth in PM peak period VMT is expected to occur at a similar pace.

Figure 4-29: Vehicle Miles Traveled



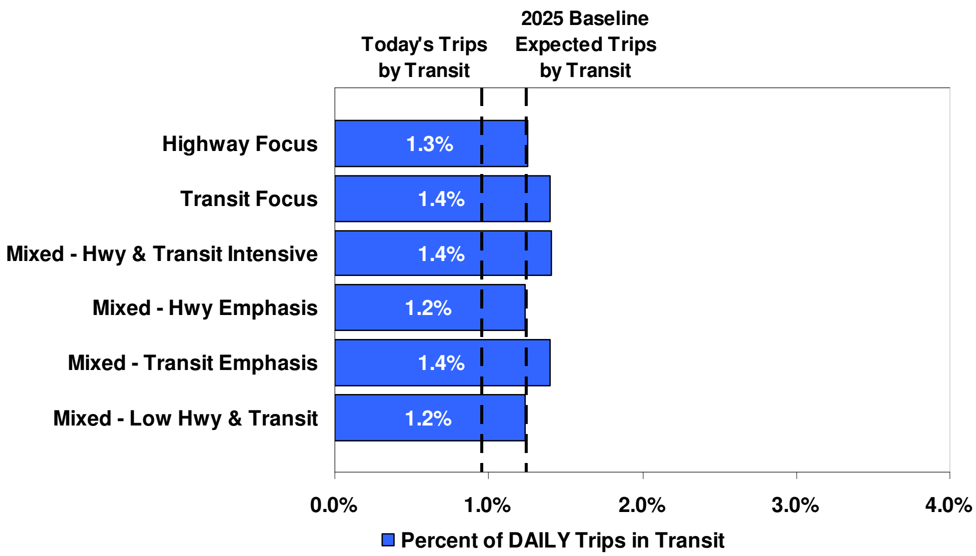


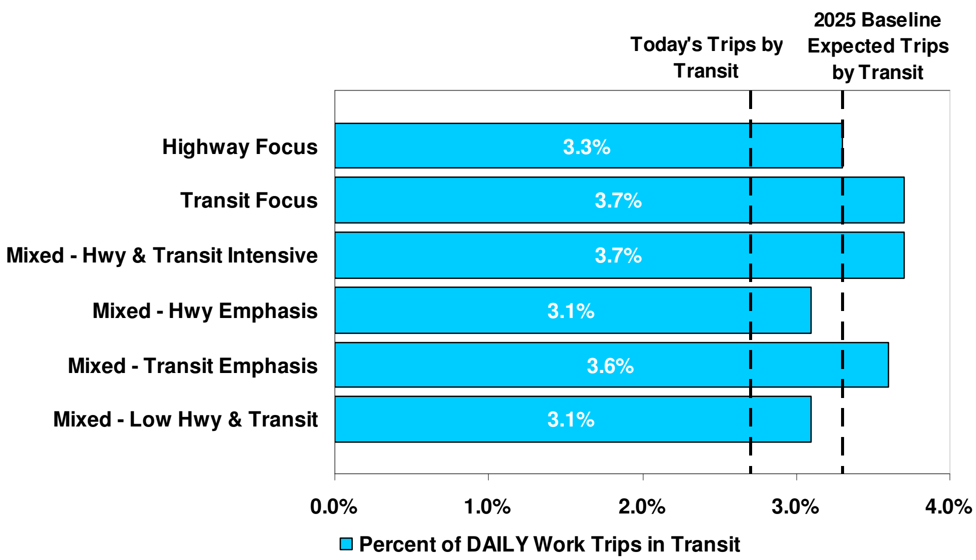
Mode Share

This metric looked at the percentage of daily trips made by transit. The mode shares represent an average of all trips and work trips only generated in the region. Figure 4-30 shows a comparison of transit mode shares across all scenarios. In the 2025 Baseline Scenario, the daily transit mode share for all trips is forecast to increase from 1% in existing conditions to 1.2%. The transit share for work trips only in 2025 is forecast to increase from 2.7% in existing conditions to 3.3%.

Compared to the 2025 Baseline Scenario, transit mode shares for both work trips and all trips would increase by approximately 13% for the three scenarios with transit improvements. The transit mode share would remain unchanged for the Highway Focus Scenario, Highway Emphasis, and Low Highway scenarios.

Figure 4-30: Transit Mode Share





4.6 Cost Estimates

This section summarizes the cost estimates for the six scenarios above and beyond those costs that would be associated with the existing system plus committed improvements included in the 2025 Baseline. Additional perspective on costs, particularly as they apply to the economic analysis comparisons, follows in the next section.

The cost estimates focused on the public costs for implementing, mitigating, operating and maintaining the infrastructure investments associated with each scenario, relative to the 2025 Baseline Scenario. Separate calculations were made for the following cost elements:

- Capital costs, including:
    - Design and construction;
    - Right-of-way / property takings;
    - Roadway environmental impact mitigation; and
- Operations and maintenance costs.

Capital Costs

Capital costs are expressed as estimated ranges in constant 2003 dollars, in part to facilitate the economic analysis, but also because the detailed construction schedules required for producing year of expenditure estimates were not developed.

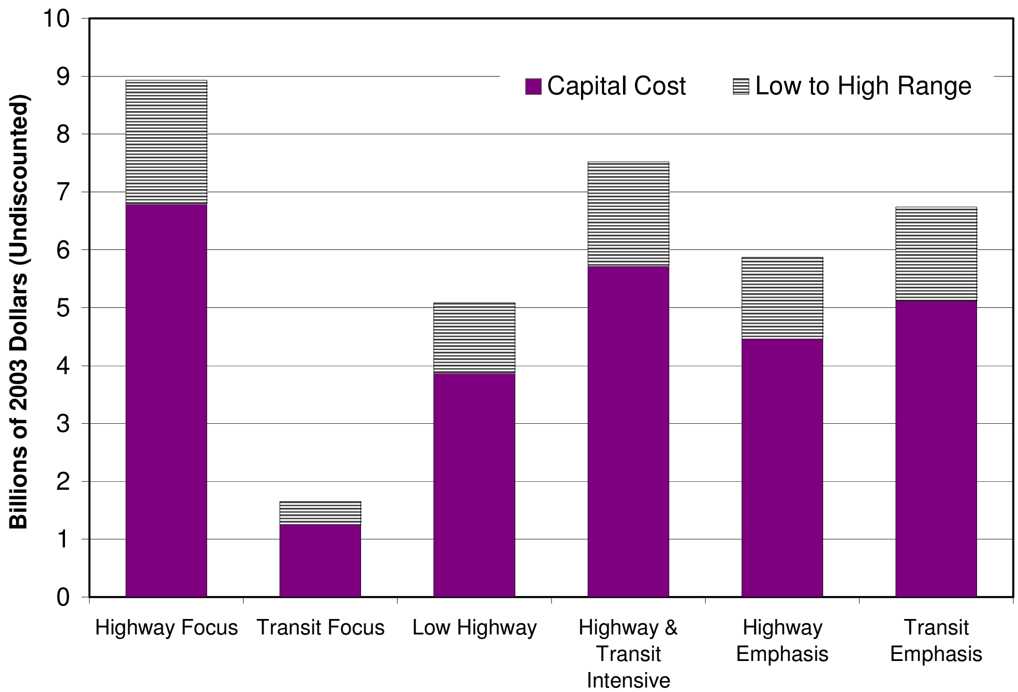
All capital cost estimates were produced as ranges around expected values to account for estimation error due to lack of design details and uncertainty in producing future cost estimates. The procedures used for establishing the cost range were similar to the WSDOT Cost Estimation and Validation Process (CEVP), though applied at a somewhat more conceptual level. The cost range established for highway and transit infrastructure and associated elements subtracted 5% from the expected cost value to set the range low end and added 25% to the expected value to set the range high end.

Table 4-6 and Figure 4-31 collectively show the overall future capital cost ranges for the six scenarios analyzed for the Spokane area. The capital investments examined in all of the scenarios for this study would be in the billions of constant 2003 dollars.

Table 4-6: Capital Cost Expected Values and Ranges by Scenario

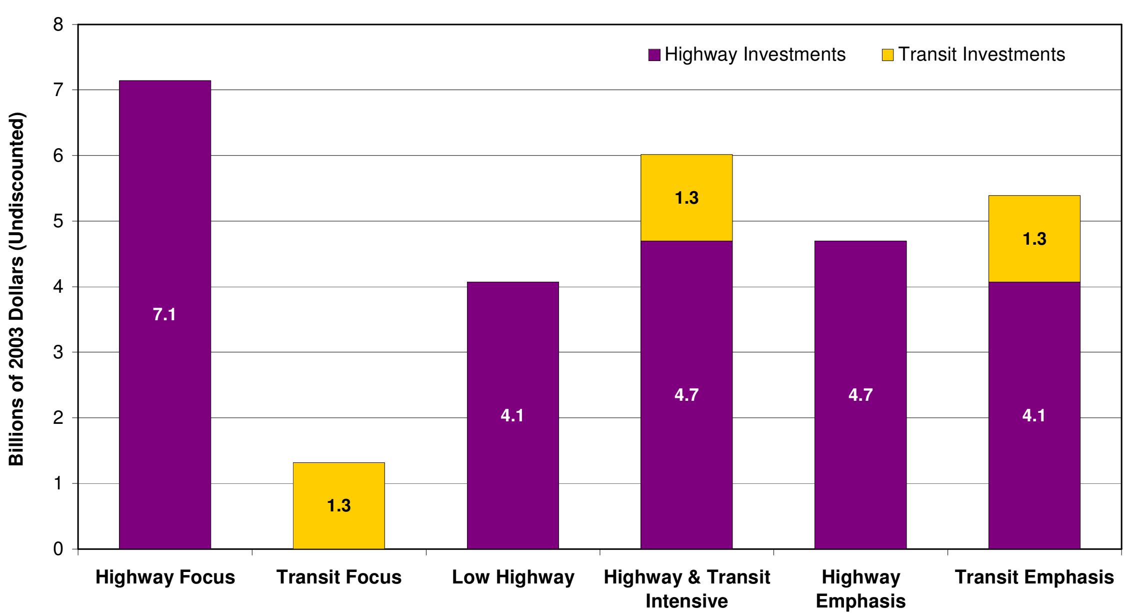
Scenario	**Capital Implementation Costs in Constant Dollars***		
	Low End of Range	Expected Value	High End of Range
Highway Focus	$6.8 B	$7.1 B	$8.9 B
Transit Focus	$1.3 B	$1.3 B	$1.6 B
Low Highway	$3.9 B	$4.1 B	$5.1 B
Highway & Transit Intensive	$5.7 B	$6.0 B	$7.5 B
Highway Emphasis	$4.5 B	$4.7 B	$5.9 B
Transit Emphasis	$5.1 B	$5.4 B	$6.7 B
* Billions of year-end 2003 dollars before present value discounting			

Figure 4-31: Capital Cost Ranges by Scenario (2003 $ in Billions)



It is useful to illustrate the magnitude and relative mix of investments by mode or application within the Spokane area. Figure 4-32 depicts the capital cost expected values for each scenario's range segmented by investment type.

Figure 4-32: Capital Cost Expected Values by Investment Type (2003 $ in Billions)



Design and Construction

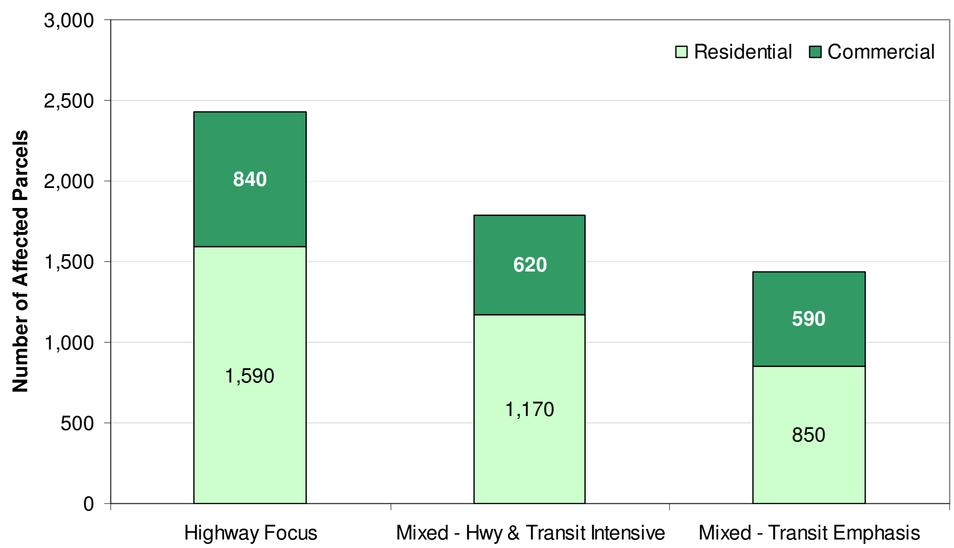
Design and construction cost estimates were developed using models based on unit price estimates for 'typical' roadway sections, interchanges, and transit elements for light rail transit, bus rapid transit, commuter rail, buses, and park-and-ride lots. Models of interchange, roadway, and transit elements were developed and modified with input from WSDOT and local transit agencies to reflect area case histories. These cost models were applied to the highway and transit improvements on a segment-by-segment basis to compute the design and construction cost estimates.

Right-of-Way / Property Impacts

The amount of additional right-of-way that would need to be purchased was calculated based on the width of unused existing right-of-way, as determined from GIS data, and the additional width needed for the number of lanes that would be added over the length of each corridor. Figure 4-33 shows the total estimated number of affected parcels; the affected parcels include properties that would potentially require relocation.

All scenarios would potentially result in substantial right-of-way needs and property impacts. The greatest impacts would be associated with roadway-related improvements. The Highway Focus Scenario would affect an estimated 2,430 parcels, and the Highway Emphasis Scenario would potentially affect an estimated 1,790 parcels. The Transit Emphasis Scenario would potentially affect an estimated 1,440 parcels. Transit right-of-way needs were identified in specific corridors where the need was apparent. In most corridors, however, transit improvements were assumed to occur within existing transportation rights-of-way, usually on aerial guideways.

Figure 4-33: Right-of-Way/Property Takings



Potential Roadway Environmental Impact Mitigation Costs

Costs for mitigating potential wetland and stream impacts were estimated**.** The project team used Geographic Information Systems (GIS) software to assist the cost estimate by overlapping the transportation improvement scenarios with the locations of known wetlands and streams in the study area. All scenarios would have some impact to wetlands and streams. The greatest potential for impacts would be associated with highway-related improvements, although new transit maintenance facilities, stations, and park-and-ride facilities would also have the potential to affect wetlands and streams. The Highway Focus Scenario would have the greatest potential for wetland and stream impacts, followed by the Highway Emphasis and the Highway and Transit Intensive Scenarios. Figure 4-34 and Figure 4-35 illustrate the potential estimated impacts to streams and wetlands used in developing cost estimates.

Figure 4-34: Potential Wetland Impacts

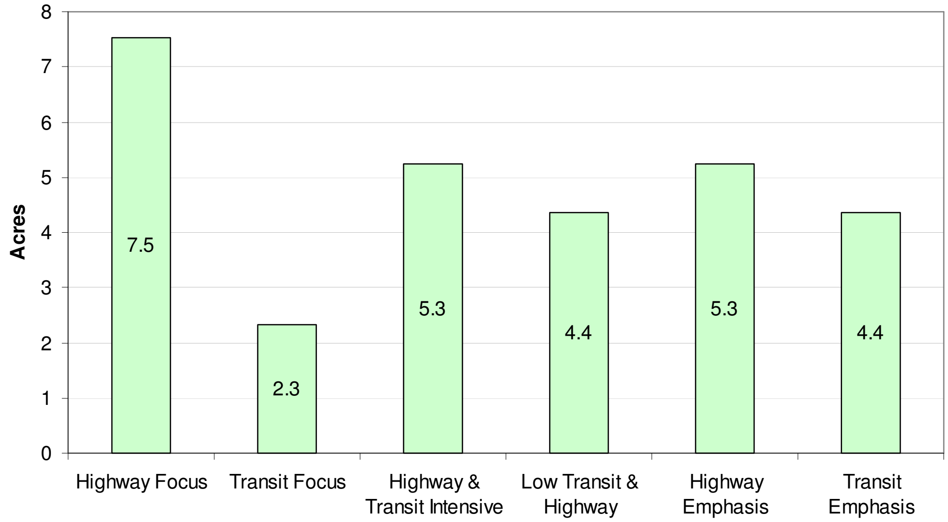
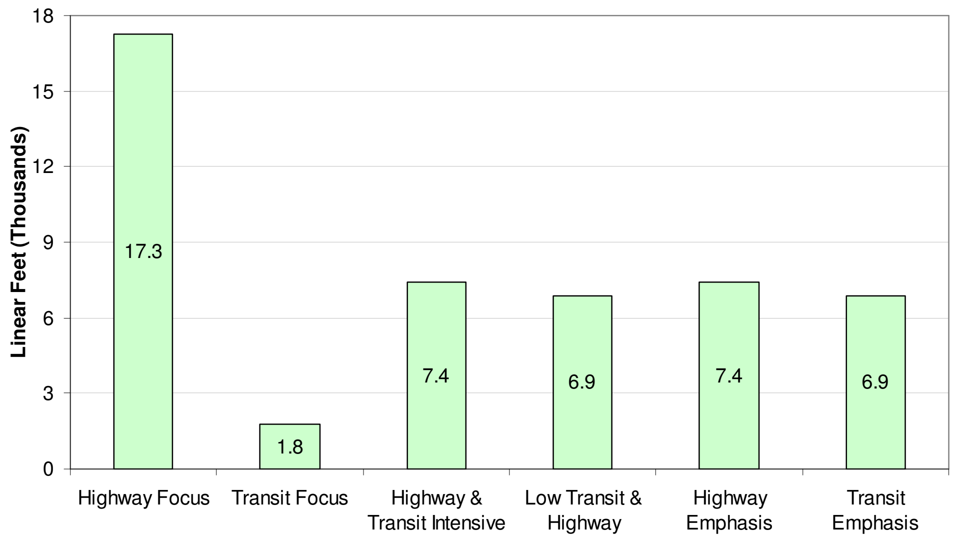


Figure 4-35: Potential Stream Impacts (Linear Feet)

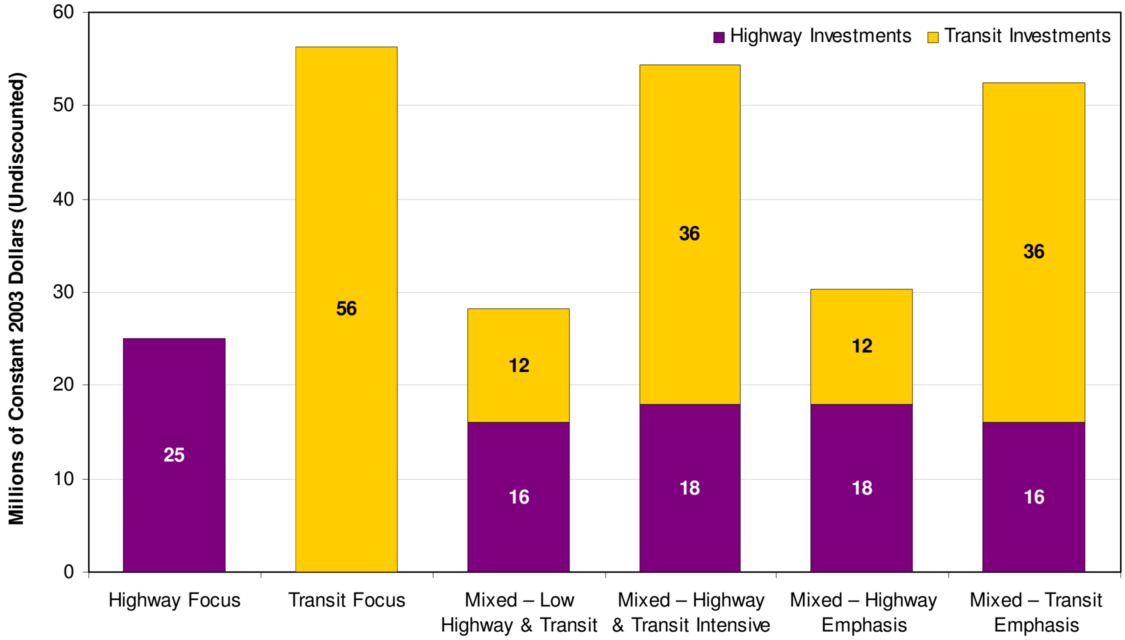


Operations and Maintenance (O&M) Costs

The annual costs to operate and maintain (O&M) the additional facilities assumed in each scenario were estimated and shown in Figure 4-36. These costs represent the incremental O&M activities of each scenario above and beyond those costs associated with the 2025 Baseline, which alone is projected to be in the range of $74 million annually (2003 dollars).[6]

[6] Sources: HPMS 2003 Data from WSDOT HQ, WSDOT HQ Bridge Preservation, and Parsons Brinckerhoff.

Figure 4-36: Annual O&M Costs by Application / Investment Type (2003 $ in Millions)



Note that O&M costs are categorized as either highway or transit expenditures for each scenario, and that the highway costs include an annual factor for relatively infrequent renewal activities such as pavement rehabilitation.

Economic Analysis

A limited economic analysis of the scenarios was conducted to help assess each scenario's incremental benefits and costs relative to the 2025 Baseline Scenario. A more comprehensive economic benefit-cost analysis was conducted for the other two urban areas of this study in which a combination of user and societal mobility benefits were assessed for the year 2025 and compared with the annualized costs of each scenario. The analysis involved using the Federal Transit Administration's SUMMIT model, a complex program that interfaces with a regional travel demand model to estimate all changes in users travel costs at a disaggregate level, and then sum these values to arrive at total mobility benefits. However, a problem regarding the interface between the SRTC travel demand model and SUMMIT precluded the application of this user benefit estimation approach in this urban area. For reasons of consistency with the analysis in the other urban areas, an alternate approach to estimating user benefits was not pursued. It should be noted that the SRTC has recently embarked on a major refinement of their regional travel demand model including the migration to a new software platform. WSDOT may want to revisit the application of SUMMIT to estimate user benefits when the model refinement and migration process has been completed.

A more detailed discussion of the economic benefit-cost analysis methodology can be found in Chapter 1 and in the *Benefit-Cost Analysis Methodology Technical Memorandum* (Parsons Brinckerhoff, November 2004) included as Appendix A.

Cost Measures

According to standard benefit-cost analysis practice, costs are defined as the public costs for implementing, mitigating, operating and maintaining the infrastructure investments associated with each scenario, relative to the 2025 Baseline Scenario. Any other costs (i.e., those borne by travelers) are considered in the assessment of benefits as disbenefits or negative benefits. For example, an increase in user travel costs is measured as a deduction to the benefits that user receives rather than as an increase to the infrastructure costs.

Capital investment costs are expressed as estimated ranges in constant 2003 dollars in order to avoid needing to make inflation projections. These cost ranges were then annualized — converted to an annual lease payment — to facilitate combining them with annual O&M costs. Annual operations and maintenance (O&M) costs reflect anticipated yearly expenditures for 2025 and include an annual factor for more infrequent but recurring renewal costs. The combined annual capital and O&M cost ranges for each scenario represent the yearly cost for the investments, and will facilitate direct comparison with 2025 annual benefit ranges if these become available at a later time.

Table 4-6 on page 4-36 of the preceding section shows the overall future capital implementation cost ranges, including the expected values, for the six scenarios. Table 4-7 below shows the expected values within the range, and their associated annualized amounts or equivalent annual lease payments. It also shows the annual O&M costs. All values are in constant 2003 dollars before present value discounting.

Table 4-7: Capital Cost Total and Annualized Expected Values and Annual O&M Costs

Scenario	**Capital Implementation Costs in Constant Dollars***		
	Total Expected Value (Range "Midpoint")	Annualized Value (Equivalent Lease Payment)	Annual O&M Costs
Highway Focus	$7.1 B	$338 M	$25 M
Transit Focus	$1.3 B	$80 M	$56 M
Low Highway	$4.1 B	$186 M	$16 M
Highway & Transit Intensive	$6.0 B	$294 M	$74 M
Highway Emphasis	$4.7 B	$214 M	$18 M
Transit Emphasis	$5.4 B	$266 M	$72 M

* Billions (B) / Millions (M) of constant year-end 2003 dollars before present value discounting

Benefit Measures and Economic Analysis Metrics

For the other two urban areas studied, user benefits accruing to both personal and commercial users represented the vast majority of the benefits quantified and valued. Societal benefits were combined with the user benefits in the other two regions to yield total benefits. However, societal benefits — estimated from changes in the number of accidents, changes in the levels of accident congestion delay, and changes in auto ownership costs — represented only a very small proportion of overall benefits, and in most scenarios they were negative in value (disbenefits). In the absence of estimated user benefits, societal benefits/disbenefits were not estimated for the Spokane urban area. It is likely that the societal impacts would have been negative (disbenefits) in all but the Transit Focus Scenario due to expected increases in VMT under the other scenarios.

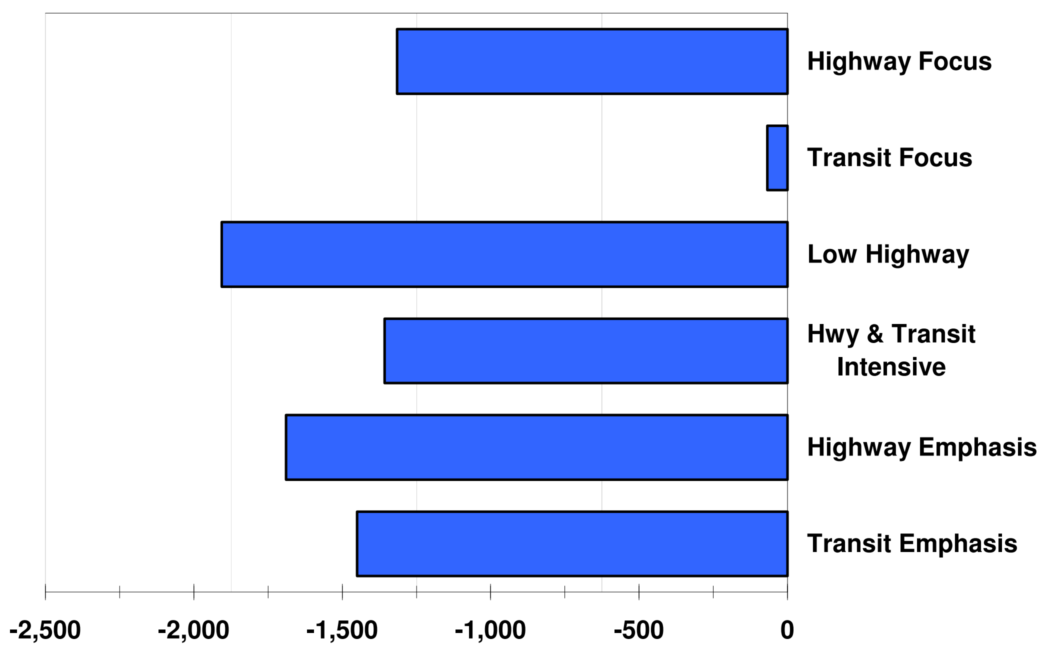
In the absence of more detailed benefit estimates, the economic analysis for the Spokane area focuses on an analysis metric that measures the delay reduction per unit of capital investment.

This metric relies on direct outputs of the regional model in terms of changes in travel times, and is comparable to the same metric calculated for the other two urban areas.[7]

Annual Person-Hours of Auto Delay Savings per $1 Million Invested
This economic analysis metric compares each scenario's primary benefit of travel time savings against the primary cost of capital investment.

Figure 4-37 shows the annual[8] quantity of delay reduction experienced by personal vehicle users, expressed in person-hours saved, and compares it to the level of capital investment for each scenario. This yields a measure of the annual person-hours of delay savings per $1 million invested.[9]

Figure 4-37: Total Annual Person-Hours of Delay reduced per $1 Million Capital Investment



This figure illustrates that the Transit Focus Scenario does not generate comparable delay savings per unit of investment with the other scenarios. This is due to the relatively low mode share for transit, which approaches 1% under the Transit Focus Scenario investments. While the transit investments likely provide noticeable time savings for existing and new transit users, these investments are not predicted to significantly reduce auto use. As such, they do not have much of an impact on vehicle delay savings.

[7] Note that person-hours of auto delay savings by scenario from the model are a proxy measure for the time savings benefits accruing to users because this measure does not fully reflect the changes in consumer surplus that result from trip redistribution and modal shifting relative to the baseline. More information on this topic can be found in Appendix A.
[8] The annual savings are for 2025, and would be different for other years.
[9] Person-hours of delay savings applies to personal travel in the highway/auto mode only; it does not include delay savings accruing to transit users even though the scenarios include transit investments.

4.7 Environmental Review

An accurate assessment of environmental impacts can only be accomplished at the project level where detailed design information is available. Since developing project-level information is beyond the scope of this analysis, an environmental review was performed to compare the potential impacts of each of the scenarios, based on the information at hand. The purpose of the environmental review was to identify the primary environmental factors contributing to the costs of each scenario, as well as other impacts not easily quantified. Those impacts contributing to scenario costs (right-of-way, wetlands, and streams) are discussed above. Other impacts, such as air quality, noise, land use, and low-income/minority populations are discussed below.

Air Quality

Air quality impacts were assessed based on outputs from the travel demand forecast model, including link volumes, speeds, and travel distances. Emissions per mile traveled for carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NO_x) were calculated for each travel link based on the forecast operating speed for the link, emission factors from the Mobile 6.2 emissions model, and the carbon coefficient for gasoline. The number of vehicle miles traveled on each link was multiplied by the emissions per mile of travel for each link. Emissions of particulates and toxic air pollutants from automobiles are expected to vary among the scenarios similarly to the other pollutants.[10]

Air quality impacts are primarily associated with highway-oriented scenarios. Transit improvements are expected to reduce vehicle trips and/or vehicle miles traveled and therefore reduce air pollutant emissions. Air pollutant emissions would be very similar for the Transit Focus Scenario and the 2025 Baseline. The Transit Focus Scenario would serve more users without increasing pollutant emissions. The Highway Focus Scenario demonstrated mixed results: CO and NO_x would be 1-2% greater than for the 2025 Baseline Scenario because their emissions are largely influenced by changes in VMT, while hydrocarbon emissions would be less than 1% lower than the 2025 Baseline Scenario because they are largely influenced by speed and congestion. The other scenarios are expected to result in emissions between those of the focus scenarios. Increasing the level of transit investment in any scenario is expected to reduce air pollutant emissions, because transit use reduces VMT.

It is expected that all scenarios would meet regional conformity requirements, but would require additional analysis to demonstrate conformity.

Noise

Noise impacts were analyzed based on changes in VMT compared to the 2025 Baseline Scenario. While this approach does not identify all areas that would experience transportation noise impacts, it identifies locations where traffic noise would noticeably increase as a result of a scenario. Noise impacts are primarily associated with highway improvements, although steel-wheeled transit vehicles would also produce some noise impacts. Traffic noise levels near major facilities would be substantial under all scenarios, much as they are today.

Each of the focus scenarios would create new noise impacts compared to the 2025 Baseline Scenario. The Highway Focus Scenario would have the most potential for creating noise impacts, caused by the addition of new facilities (i.e., additional lanes) where traffic volumes and speeds would increase. The other four scenarios would also result in potential noise impacts, particularly

[10] The analysis was link-based. The basic process was to: 1) calculate the speed on each link, 2) calculate the emission factor (based on the modeled speed for the link), 3) multiply emission factor for each link with the VMT for the link, and 4) add up the entire network).

along the routes where improvements were contemplated, although not as extensive as the Highway Focus Scenario. Transit improvements would not be anticipated to result in substantial traffic noise impacts at the system level, but could create localized noise impacts along new rail alignments.

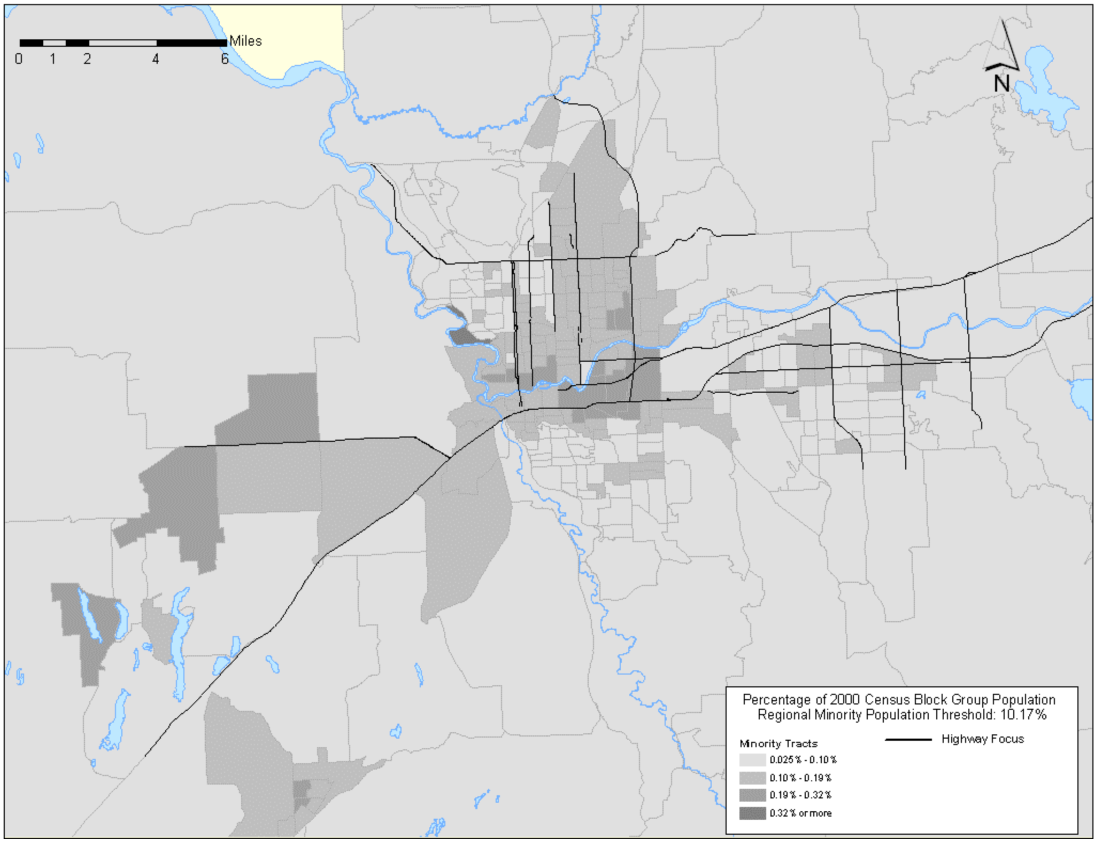
Minority and Low-Income Populations

The focus of the minority and low-income population analysis was to generally identify the location of these populations within the region and to discuss potential impacts associated with each of the scenarios. Procedures for analyzing potential impacts in the Spokane area were developed in consultation with WSDOT and the SRTC, and relied on data from the 2000 US Census. The analysis considered both direct and indirect impacts on these populations.

The Spokane area has concentrated areas of low-income and/or minority communities. These areas are adjacent to many of the capacity improvements that were analyzed in the scenarios. To illustrate this point, Figure 4-38 and Figure 4-39 show where the Highway Focus Scenario would potentially interact with minority and low-income populations.

The highway-oriented scenarios would have a higher potential for direct impacts in the form of right-of-way and property acquisition, increased noise levels, and impacts to air quality. The Highway Focus Scenario and the Highway Intensive Scenario show the greatest need for right-of-way acquisition, which could potentially affect low-income and minority populations living and/or working adjacent to the study corridors. Increases in noise and vehicle emissions also could impact nearby low-income and minority communities. Transit-related scenarios that include park-and-ride and maintenance facilities have a similar potential to impact low-income and minority populations. However, these impacts are anticipated to be smaller and more localized than the large-scale highway scenarios. More detailed information on both the nature of the improvement and the composition of the existing populations would be required to determine the extent of the impacts and whether or not low-income or minority communities would be disproportionately affected.

Figure 4-38: Minority Census Tracts and the Highway and Transit Focus Scenarios



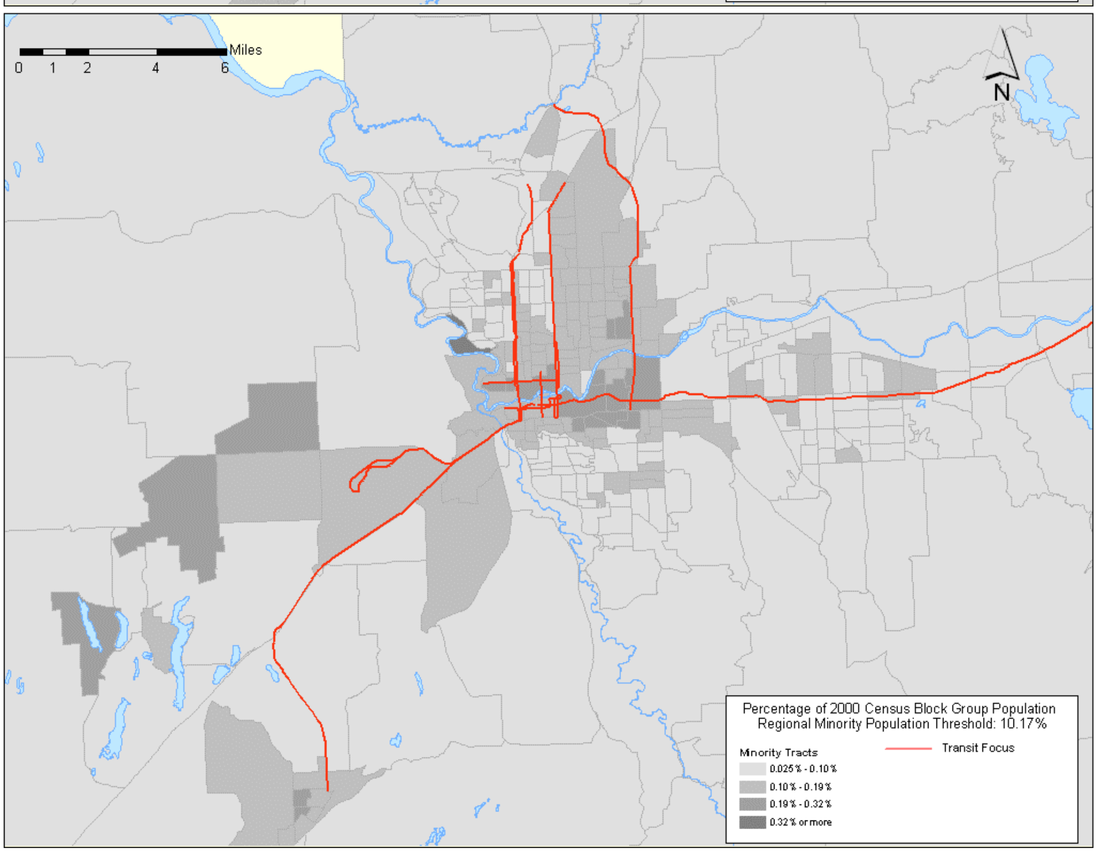
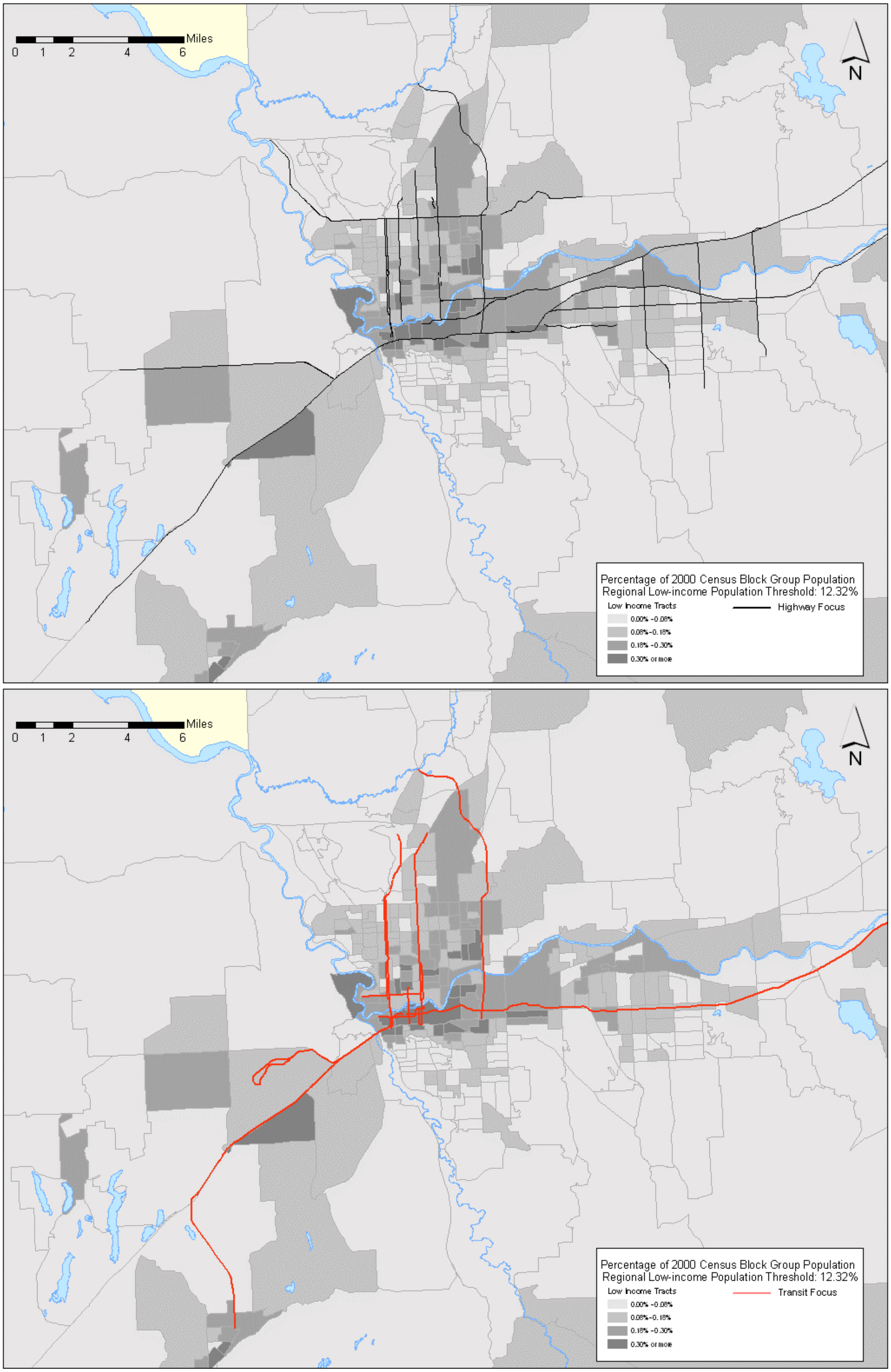


Figure 4-39: Low-Income Census Tracts and the Highway and Transit Focus Scenarios



Each of the scenarios also has the potential for indirect benefits and impacts. Providing additional transportation capacity, whether in the form of highways or transit, provides improved access to employment, health care, shopping, and other community facilities that benefit all population groups. Offering more transit service tends to benefit persons who cannot drive or do not own cars. The highway-oriented scenarios provide travel time benefits to all population groups.

Land Use

The interaction between land use and transportation is widely recognized; however, the relationship is complex and has been the focus of much debate. In this analysis impacts on land use were examined from three perspectives:

1. How well do scenarios meet current growth management requirements?
2. Do the scenarios match the plans and policies of jurisdictions?
3. What is the potential conversion of land to transportation uses?

This study evaluated how well different transportation scenarios serve the planned growth as described in regionally-adopted land use plans. Most of the capacity added in the scenarios is located within the currently established urban growth areas. This suggests that the added highway capacity would not necessarily induce significant growth outside established urban growth areas. However, it is conceivable that additional capacity could alter growth patterns within the urban growth boundaries. To quantify the potential land use changes would require an extensive modeling of transportation-land use interactions. Considering the number of scenarios analyzed and the nature of the study, the study team concluded that this iterative analysis would be more meaningful in a subsequent phase.

Land use was also analyzed from the perspective of consistency with regional plans and policies. For the most part, each of the highway and transit scenarios contains elements that are consistent both with the SRTC's Metropolitan Transportation Plan as well as the plans of local jurisdictions. The Highway Focus Scenario and the Highway Emphasis Scenario include the addition of several roadway segments that go well beyond currently adopted comprehensive plans. However, most of the additional roadway capacity would be consistent with level of service and concurrency policies that support reduced congestion. The other scenarios are the most likely to be consistent with land use plans and policies because they provide multiple transportation options and a more balanced system.

The potential conversion of land to transportation uses can be assessed based upon the location and magnitude of the improvements. The highway-oriented scenarios have the most potential for conversion of existing land uses to roadway functions because of right- of-way needed for such improvements. The transit-oriented scenarios have less potential for direct land use impacts because less right-of-ways would be needed. The other scenarios are somewhere in between.

4.8 Suggestions for Future Studies

The results of the analysis for the Spokane area provide information that may be useful for future planning efforts. During the course of the analysis, several issues arose that could not be fully explored in the context of the identified scope of the study. These issues include:

- Potential effects of congestion strategies on land use allocation and mix;
- Corridor effects of transportation demand and system management strategies related to land use characteristics; and
- Effects of potential funding strategies on overall travel demand and travel patterns.

These topics may be considered in subsequent phases of the Congestion Relief Analysis or other planning studies.